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ENGINEERING AND
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METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

McGRAW-HILL PUBLISHING COMPANY, INC.

July 3, 1926

A Quarter Century of Mining Progress

By George J. Young

Amazing development in the last twenty-five years has been witnessed in the industry. Flotation and other metallurgical processes have increased recoveries and converted into ore material formerly wasted. Undercut caving and other mining methods have lowered the cost of operation. Mechanical loaders and equipment have in large part supplanted manual labor. Substantial advance in geological knowledge has been made. Finally, a transition of mining to an international basis has marked the period.

ROCK DRILL LUBRICATION, by I. M. Marshall—THE RED LAKE GOLD AREA, by Douglas G. H. Wright—Biography of William Everett Thorne

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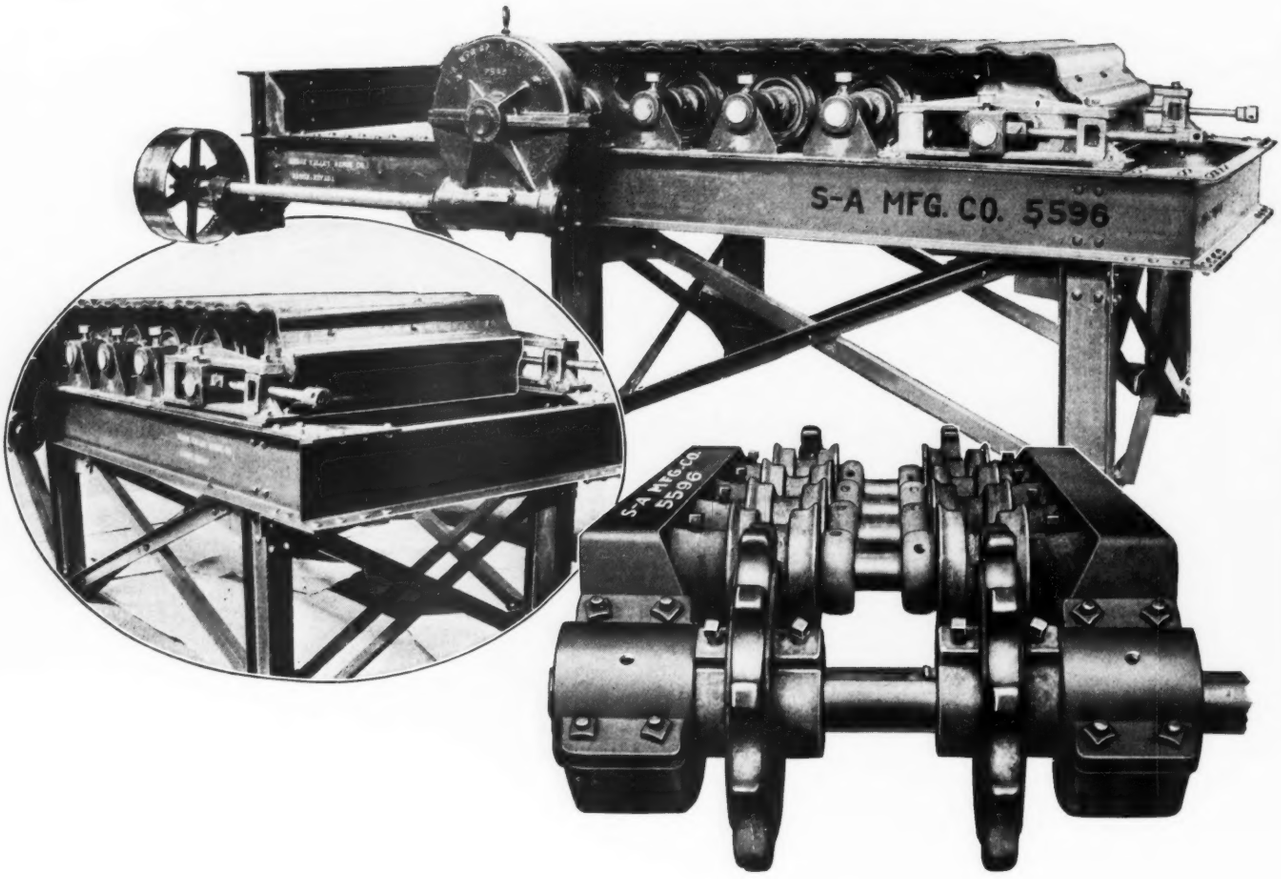

THE large diameter rollers which carry the links of the chain in the S-A Roller Track Feeders is a good example of the S-A expert design in this class of equipment.

These large rollers insure long wear under the very hardest service, as wear is reduced to a minimum.

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ENGINEERING AND
MINING JOURNAL

JOSIAH EDWARD SPURR, Editor

Volume 122 **New York, July 3, 1926** *Number* 1

Engineering and Mining Journal

Engineering and Mining Journal was founded in 1866 as the *American Journal of Mining*, with George Francis Dawson as Editor. In 1869 the name was changed to *Engineering and Mining Journal.*

Publications which have been absorbed are: 1875, *Coal and Iron Record;* 1877, *The Mining Review* (Denver); 1879, *The Polytechnic Review;* 1902, *Mining and Metallurgy;* 1906, *Mining Magazine;* 1917, *Engineering and Mining World.* The successive editors have been Rossiter W. Raymond, Richard P. Rothwell, Fred Hobart, David T. Day, T. A. Rickard, and W. R. Ingalls. In 1919 J. E. Spurr became Editor.

On April 1, 1922, *Engineering and Mining Journal* was consolidated with *Mining and Scientific Press* as *Engineering and Mining Journal-Press.*

The *Mining and Scientific Press* was established in 1860 as the *Scientific Press.* Three years later "Mining" was added to the title. The successive editors have been Almond D. Hodges, Charles G. Yale, J. F. Holloran, T. A. Rickard, and H. Foster Bain.

On July 1, 1926, the paper reverts to its old name, *Engineering and Mining Journal.*

The staff of the *Engineering and Mining Journal* consists of J. E. Spurr, Editor-in-Chief; T. A. Rickard, Contributing Editor, San Francisco, Calif.; George J. Young, Associate Editor, San Francisco, Calif.; A. H. Hubbell, Managing Editor; E. H. Robie, A. B. Parsons, A. H. Fay, W. N. P. Reed, Assistant Editors.

The World's Mercury

THE MERCURY SITUATION of the United States and the rest of the world has just been set forth in a report of unusual conciseness, by J. W. Furness and R. M. Santmyers, of the U. S. Bureau of Mines. The United States production, which around 1850 was in the neighborhood of 20,000 flasks, reached its peak of 79,000 flasks in 1877. "Since that date, in spite of the assistance given by import duties and high prices, domestic production has steadily decreased." In 1925 the estimated production was around 9,000 flasks. In 1911 imports exceeded exports for the first time, and since that time the imports have been constantly increasing. The other two chief sources of supply have been that of Idria, which was under Austrian rule till the Great War, and is now Italian; also Monte Amiata, in Tuscany (Italy); and, second, the Almaden district, in Spain. The Italian districts have increased their output largely and steadily: from 4,000 flasks around 1850 it rose to 48,000 in 1925. The Spanish district increased only from 20,000 to 26,000 in the same period.

Of these three regions the Spanish one has the richest ore, having for many years averaged over 6 per cent recoverable mercury; the United States (chiefly California) the leanest averaging from 1915 to date only 0.43 per cent. The Italian districts have averaged 0.7 per cent. Methods of mining and reduction have been highly efficient in the United States and Italy. They have been crude and wasteful in Spain. Yet owing to the high grade of the ore, the cost of Spanish mercury is the least: it was estimated in 1918 that United States costs were around $60 to $70 per flask, in Italy $15 to $35, and in Spain $10 to $25. "It is not likely that new methods of producing quicksilver can be evolved which will bring the domestic cost even part way down toward a figure comparable to that of Spain. Under normal market conditions the continuance of the domestic industry is problematical."

This is the situation in spite of the heaviest import duty ever levied, which was placed in the 1922 schedule at 25c. per lb., or $18.75 per flask. The average market price of mercury in 1925 was $83 per flask. Concerning the California deposits, which have been the source of 95 per cent of the United States production, the authors write: "The tenor of the mercury ore now treated in California is lower than any now handled elsewhere in the world. Economic exhaustion undoubtedly will take place within a few years, as there are no known undeveloped extensive deposits even of low-grade ore."

The Idria mines have been worked from the time of the ancient Etruscans, many of them are worked out, and the region as a whole is rapidly approaching exhaustion. The Monte Amiata mines are now the greatest producers of Italian mercury; they will probably be able to maintain their present rate of production for twenty years. In the future the ore reserves of Spain, which are the largest known, will have to be drawn on heavily.

Higher prices for the metal seem inevitable, with the expanding industrial uses. Hitherto there seems to have been no artificial control of prices, although since 1919 Spain and Italy have had the power to do so.

Asbestos in Time of War

THERE IS A DEMAND by producers of asbestos in the United States for a protective tariff on asbestos, based on the argument that it would be a great benefit to this country in time of war. It is further argued that as an accepted economic verity permanent relief to the languishing asbestos industry will come only when Congress has established a tariff against the more cheaply produced foreign product, which now enters this country free of duty. One of the tariff proponents says:

> "I do not exaggerate in the least when I say that the present situation may become a national calamity in times of stress, if, for instance, Great Britain should be involved in a war and should require all Canadian asbestos, having none to spare for the United States. Our experience during the last war has shown how dangerously near we have come to such a situation.
>
> "The United States today is by far the largest consumer of asbestos in the world. Our own production covers but a small fraction of our constantly growing needs, and yet we have probably the largest asbestos reserve of any in the world, and certainly the richest deposits of the highest quality of asbestos known to exist anywhere."

If we have, as he states, the "largest reserves," the "richest deposits," and the "highest quality of asbestos known to exist anywhere," then we will be secure in time of war. If with these declared conditions American asbestos cannot compete with the Canadian product, then there is something wrong with the asbestos management. Mass production should be easy. One difficulty is that our deposits are not as near our industrial centers as are the Canadian deposits, our chief source of supply. If, on the other hand, our resources are limited, then a tariff would greatly aid in depleting these reserves until in time of emergency we might be found with exhausted mines as our heritage.

Asbestos is an essential in many industries, and inasmuch as we believe our supplies are less abundant than those of our neighbors, anything that will conserve them for war-time uses should have the right of way. The same may be said of tungsten, chromium, manganese, and a number of other minerals.

The Pin-Wheel Theory for Joplin

LET THE GEOLOGIST of vivid and fecund imagination blush and take off his hat to Perry Crossman, veteran well driller of Joplin, whose recent interview in the *Joplin Globe* gives his theories as to the geology of the district. Joplin has always inspired geologists to feats of imagination. It is said, for example, that several engineers and geologists there have evolved the startling theory that the great zinc deposits have been concentrated by rainwater from an invisible state of dissemination in ordinary rocks. This is the extreme and fabulous form of the uniformitarian theory —that things always was as they is, or is as they always was. At the extreme of the opposite or catastrophic theory—clear at the other pole from the Rain-in-the-Face engineer—stands heroically Perry Crossman. Says he:

"The Mississippian lime is of volcanic origin. We find limestone, flint, soapstone, slate, sand stone, asphalt, zinc, lead, pyrite, coal, and manganese all piled together. I have seen them all within a cubic yard in the mines. I have found a cube of lead 8 in. square, completely surrounded by 4 ft. of limestone." And as to the age, one has fossil evidence: "I found a petrified stake in limestone that showed marks of an axe being used to sharpen it. I have a well defined bone from a human foot with ankle and a part of the bone of the leg, which was found on the thousand acre tract." As to the stratigraphic deformation, "the limestone is laying eggshaped in a circle." As long as the limestone was laying, what more natural than to have it lay eggshaped—does not the sparrow do as much, showing clearly a natural law? This is far better than incorrect theories. Says Perry: "I have learned the well known fact that many geological theories have been exploded by cuttings obtained from drilling artesian wells and drill holes." Indeed, the Joplin district has been a great place for explosions. You cannot carelessly lay (note the verb) a theory down anywhere in Joplin, but the durn thing will explode. It is an age-long habit in Joplin, as Perry explains:

"As to the formation of this huge egg-shaped limestone boulder, I believe I can give as good an answer as anyone, as there is plenty of room for guess work. Three holes that I have drilled in Jasper County have gone into red granite at a depth of 1,900 ft. This great boulder formation may have been lifted out of the old mines of Germany, blown half-way up to heaven, caught by a strong east wind, finally dropping into the soft shales of the coal and oil fields that surround the district today, and it did not stop sinking until it hit that red granite. If not, it was pushed up through that red and gray granite, and when released, went whirling, like a great cannon ball miles up in the air, and then fell back into these soft shales. The only way to find out the source of this egg-shaped rock is to bore a hole through and beyond the granite. If the boulder came from above, then shales, that bear oil and gas, will be found below. If the boulder came from below, then big fissure veins of lead and zinc will be found."

This is the view of the practical miner and driller, with which may be contrasted the theoretical ideas of the bespectacled engineer and geologist. Perry himself explains the futility of trained geologists: "It was in the summer of 1879 that James Broadhead and Van Cleve Philips, geologist of note, visited the district. They spent several months making a survey of the district. I remember the spot where, with mallet and chisel, they made a cross in a limestone rock. They told Judge O. H. Picher, Will Picher and myself that 'this limestone is the bed-rock of the country, and that it was useless to try and find ore in this hard, igneous lime and flint.'"

Hardly a man is now alive who remembers that famous day and year; and there were giants in those days. Doubtless the cross is still on the limestone rock to prove the historical veracity of the traditional record. But after studying with great respect the ultra-catastrophic explanation above cited, which may be called the Pin-Wheel Theory, the problem of reagents came to mind and we investigated to see whether the mines at Joplin are dry, either above or below ground. They are not.

The Safety Idea

THE ENORMOUS GROWTH of the safety movement in mining is in large part a development of the last ten or fifteen years. Safety laws had been enacted long before, some of them dating back to the 60's, when the Avondale disaster caused an epidemic of legislation having the protection of the miner as its object. This earlier activity was largely confined to coal mines. The metal miner, not having gas or coal dust to contend with, seemed in no particular need of attention: if ground fell, a rope broke, a foot slipped, or the hoist man made a bad mistake, these were but the mishaps of a more or less hazardous occupation. An engineer does not have to be very old to remember the indifference to carelessness in handling explosives that was often displayed in mines and the dangerous conditions under which men were frequently asked to work and under which they did work without thinking much about it. To them the chance they took was all a part of the job they had.

Today such gross carelessness is rarely seen. Management itself has become more cautious. From 1912 to 1926, the U. S. Steel Corporation spent $15,700,000 for accident prevention. Safety preachment has become the miner's daily ration, and with good results—though perhaps at times overdone. It is a work that is never finished. The education of the miner, once begun, must

be continued, for the green workman is always present and the older ones grow careless. Half of the industrial accidents in the country are attributed to carelessness. In Utah a direct appeal to employees in metal mines has been made by the State Industrial Commission in an effort to lessen the number of accidents, which totaled almost 20,000 between 1918 and 1925. This appeal is made in the form of a book of safety rules for work in the various places in a mine. A large number of miners in the aggregate are engaged in operations of modest scope where safety campaigns are rarely heard of. At such properties happen many of the accidents reported to the State Commission. Efforts to reach these scattered workmen will bring improved results in the course of time.

A New Aspirant for Engineering Honors

PLUMBERS' HELPERS, it seems, are not satisfied to have their form of service to humanity so designated, a delegate to a plumbers' convention in Los Angeles suggesting that young men entering the plumbing business henceforth be referred to as "sanitary engineers." Thus is entered still another variant of the much abused term "engineer," though it would seem that the term "sanitary engineer" must already have been pre-empted by those who make a specialty of designing sewage-disposal systems and water piping for domestic use. To be a sanitary engineer would certainly sound more dignified than to be a plumbers' helper, but it is problematical if he would be satisfied with a young engineer's salary. If he is to have the honor, let him pay the price!

Another Worry for Gold Miners?

EXPERIMENTS on the transmutation of quicksilver into gold have been reported two or three times in the last year or so, but scientific authorities are as yet unconvinced of their authenticity. Perhaps the wrong raw materials were used. Perhaps a liberal amount of silver is necessary rather than its more plebeian namesake. At any rate, a news dispatch states that Joltivet Castelot, president of the Alchemical Society of France, uses silver to do the trick, assisted by antimony and arsenic. He not only can make gold, but he is willing to tell how to do it, as follows:

"I take ten grams of chemically pure silver guaranteed free from gold and add three grams of trisulphurated arsenic and one gram of pentasulphurated antimony. After a close union I place the mixture in a crucible with the usual melting elements—borax, carbonate of soda, and niter—and heat it to a fusion for an hour in an oven about 1,200 deg. C. The slug thus obtained is next attacked by azotic acid at 36 deg. C., which dissolves the silver and part of the arsenic. The pulverized residue, after a treatment to dissolve the antimony and the remaining arsenic, is attacked with nitro-hydrochloric acid and dissolved. This liquid is chlorated and then dried and washed with distilled water. When filtered it shows, with the usual reagents, the very distinct presence of gold."

There's the secret; try it in your own cookstove. If there is difficulty in getting the azotic acid maybe some exotic acid would do as well; in fact we feel sure of it. One is reminded of the recipes in the newspapers to prevent falling hair; among several familiar drugs and chemicals there is always one that no one knows anything about, and that is the essential ingredient. But here, the trisulphurated arsenic and the pentasulphurated antimony sound rather ominous too.

Latest dispatches state that the franc has reached a new low, so perhaps France is not yet flooded with gold. Probably M. Castelot has not yet gone into commercial production.

Mining Reports for Investors and Promoters

THERE are two possible reports that may be made on any mining property: (1) A clear statement of facts as found, properly supplemented by such available data, from any source, as will make it possible for the engineer to form an estimate of the latent possibilities of the property in question. This is the kind of a report that any banker or investor requires when he intends to put *his* money into the property. He wants to know the facts, good or bad, and he will then act accordingly. (2) Another type of report is desired by the promoter who expects to draw money from the investing public. What he wants is a report so worded that it will appeal to the public, the many subscription investors, who take a long chance by investing a small amount on the strength of flamboyant advertising, or plausible statements by unscrupulous salesmen. The greed for easy money leads the small speculator to buy without knowing all the facts to which he is entitled if he wishes to make a safe investment. The promoter often goes so far as to misquote an engineer's report, by omitting any qualifying statements made by the engineer to place his client on his guard and at the same time protect his own good name.

A case recently came up in Arizona where an engineer was engaged to make a thorough examination of a mining property. It seems that the client was exploiting the property by means of a stock-sales campaign. The engineer's report was apparently based on facts as he found them, but unfortunately for the client it was not what he wanted, as it could not be used to advance his cause. The report was not accepted. He refused to pay the engineer the small fee of $750, and instituted a damage suit against the engineer for $50,000. The case came before a jury, and the verdict was rendered in favor of the engineer.

As a matter of information the engineer should find out in advance, if possible, for what purpose the report is to be used; he should look into the former records of his prospective client, his methods of doing business, his reputation, and his financial responsibility. Having taken these matters into consideration, he enters into the engagement with his eyes open, a substantial retainer to his credit, and is prepared to render a report according to the dictates of his own conscience, bearing in mind that his reputation is at stake and that he is judged by the company he keeps.

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THE INDEX to Volume 121 of the *Engineering and Mining Journal-Press*, covering the first half of the current year, is to be found immediately following page 1072 in last week's issue, dated June 26, the last of the volume.

Mining Engineers of Note

William Everett Thorne

WILLIAM EVERETT THORNE, one of the foremost gold-dredging and hydraulic mining engineers of the United States, began life on a farm in Indiana. Both of his grandfathers were hydraulic engineers, so it was natural that he should have a strong bent for the work that he selected for himself. Having received his early education in the common schools, at the age of twenty he took special work in mining at the Colorado School of Mines and later at Stanford University. For more than ten years, until 1898, he worked as a civil and mining engineer's assistant in Mexico, Colorado, Texas, and New Mexico, making his headquarters at Denver and El Paso.

At the outset, after a year's work in New Mexico in the irrigation department of the Pecos Valley and Northeastern Railroad, Mr. Thorne accepted the position at the Big Kink mine, on the North Fork of draulic mine at Georgetown, Calif., where he remained for three years and then assumed a similar position at the Big Kink mine, on the North Fork Forty-Mile River, Alaska. After a single season he became engineer for the Oro Grande hydraulic mine, at Dillon, Colo., and the next year was placed in general charge of the operations of the Snow Storm Hydraulic Co. at Fairplay, in the same state.

Mr. Thorne established himself in California in 1907 and built up a consulting practice in his chosen specialty, which had to do with all kinds of placer-mining operations. For three years he was associated with the Hammon Engineering Co., of San Francisco, and made examinations in the United States, Canada, Mexico, Central America, and Brazil. During the next three years, 1912-14, he made placer examinations for various companies in Portugal, Spain, Siberia, Russia, and Nigeria. In 1915-17 he was employed to make special investigations for the British Government in the Lena goldfields, in Siberia, and the next year, while still in Siberia, he was engaged as a consultant by the United States Government. On the completion of this special work, he became consulting engineer for the Ropp Tin, Ltd., operating in Nigeria, British West Africa. In 1922 he opened an office as consulting engineer in London. During 1923-24 he examined properties in Colombia, South America, and in British Columbia, and last year he investigated placer mines in the Belgian Congo, Northern Rhodesia, and near Capetown, South Africa. He is now retained on the technical staff of Lena Goldfields, Siberia, but makes his home in California.

Mr. Thorne is a member of the A.I.M.E., and of the Institution of Mining and Metallurgy; likewise of the Mining and Metallurgical Club in London and of the Engineers Club of San Francisco. He is also an inventor, having devised the woven-wire reinforcement for revetment work used by the Wabash Railroad. He is the author of a book on "Sampling and Estimating Alluvials."

For some time Mr. Thorne has confined his professional mining work very largely to his specialty—gold dredging and hydraulic mining. His services have been of late years almost wholly engaged by British and other companies operating in various parts of the world.

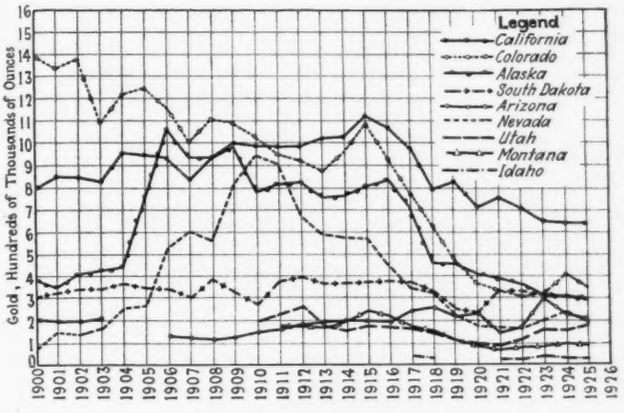
In 1898 Mr. Thorne married Sue D. Darnel. They have a family of three.

A Quarter Century of Mining Progress

How Improved Methods and Metallurgical Processes Evolved During Twenty-five Years Elapsed Since 1900—Steps in the Mechanicalization of Industry

By George J. Young
Associate Editor

LOOKING BACKWARD over twenty-five years of progress in mining brings out many high lights in the amazing development of this basic industry. Many of the readers of the *Engineering and Mining Journal* have played a part in this development; some



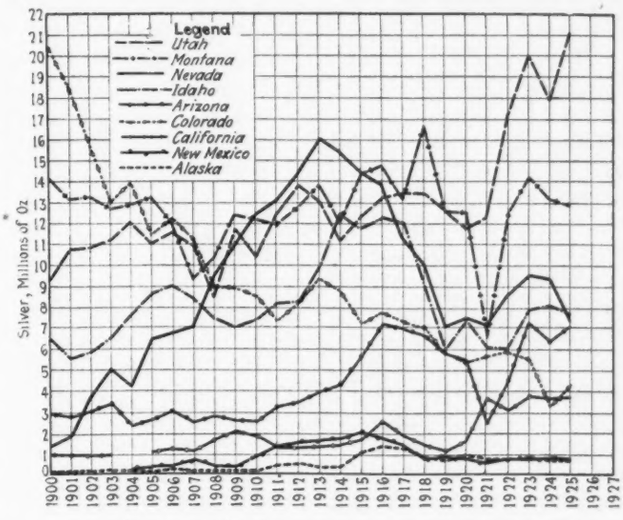
Production of gold by states (U. S. G. S.)

have made important mineral discoveries; others have made inventions that have increased recoveries of metals or have led to important economies in operation; still others have improved methods and mechanical installations or have contributed to the orderly operation of mining properties. Broad economic changes, business depressions and prosperity, high and low prices have alternated. A world war is one of the tragedies of the period, and its economic influence will continue to be felt for some years. Increased labor and technical efficiency, greater metal recoveries, the widespread utilization of electrical power, the growth of safety practices and the increase in the production of metals, minerals, and petroleum, leading to greater per-capita consumption, are the broad general features of the progress made. The growth of the chemical industry and of other manufacturing industries dependent upon metals and minerals is a noteworthy feature of the period.

Metal and mineral production is the resultant of mineral discoveries, mine and quarry operation, and technical progress. The accompanying series of curves showing the production of the important metals and some of the more common non-metallics illustrates the changes and the rise and fall of production in the several states. Each metal curve for each state involves a separate history, and each group of state production curves for each metal is a composite of the history of the mining position of the metal at different times.

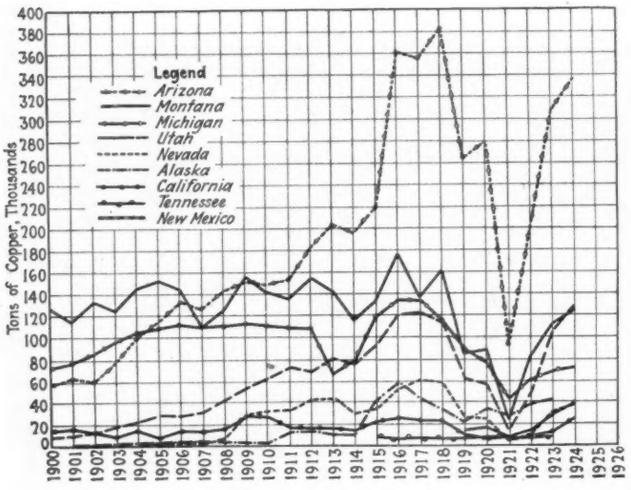
Gold is the only metal which shows a substantial decline for the period. Silver, chiefly by reason of its association with lead and copper ores and its production in part as a byproduct metal, is more than holding its own. Copper shows a great increase for the period. Zinc and lead show increases, as does also iron ore. Petroleum production records a most spectacular growth in the period. The steady increase in the output of portland cement and gypsum is a reflection of the growth in construction and house building. The minor metals and minerals—quicksilver, manganese, chrome, molybdenum, tungsten, and others—were they presented, would indicate equally interesting histories.

The last quarter century represents a tremendous growth in the aggregate and a remarkable manifestation of energy, enthusiasm, and individual and collective effort characteristic of the nation in other lines of industrial activity as well. The period opens with Colorado displaying the most varied activity in mining and with large smelting centers at Denver, Pueblo, and Leadville. The first mills, cyanide and chlorination, were being erected in the Cripple Creek district. Many stamp mills were in operation in Gilpin County, and the Leadville Pumping Association was undertaking the unwatering of the "downtown" mines. Montana, Utah, Idaho, and Arizona were also increasing in importance, but Nevada was at a low ebb. Nevertheless, attempts were being made to unwater the Comstock and to revive mining in that state. The discovery of Tonopah in May, 1900, was the kindling of interest in the Nevada area a few years later. Goldfield, discovered in 1903, accelerated interest in mining, and the two districts, Tonopah and Goldfield, did much to develop mining interest in the West, and speculation in mines attracted the public and gave impetus to the mining wave. California was just entering upon its



Production of silver by states (U. S. G. S.)

gold-dredging period and petroleum was commanding greater and greater attention. The glamour had worn off the Klondike discoveries, but Nome was beginning to attract the Argonauts. Mercur, Utah, was treating 1,800 tons per day of gold ore by a roasting-cyanide

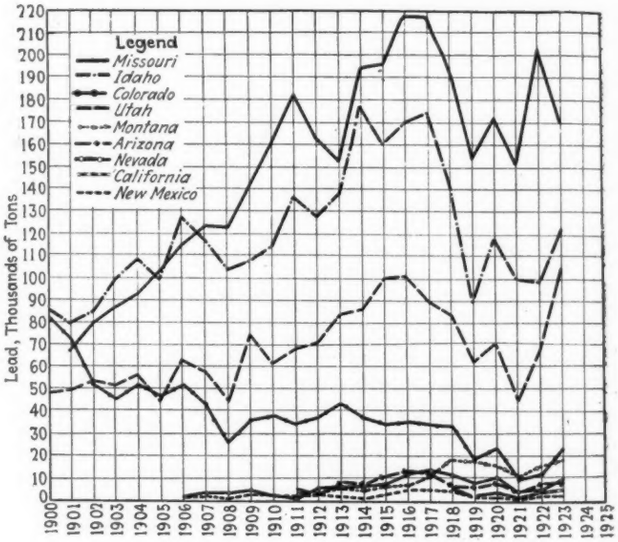


Copper production, by states (U. S. G. S.)

process. The Alaska Treadwell group of mines was fairly started on its long career. The Homestake Mining Co. was expending $1,000,000 on a new water supply, $250,000 on a new hoisting plant, and $200,000 on a cyanide plant. At Anaconda, Mont., the Washoe smelter and concentrator were being completed. At Great Falls, Anaconda was operating a large concentrator, smelter, and electrolytic refinery. The Joplin district, a poor man's camp, was beginning to attract attention, although in 1895 there were 400 concentrating mills in the district. Sudbury, which was discovered in 1896, started mining nickel ores in 1900. Iron mining was well established in Michigan and Minnesota as well as in the Birmingham district of Alabama and in other states. Copper mining in Michigan was in an advanced technical position. Coal mining was rapidly increasing in importance and position. The total coal production in 1900 was about 256,000,000 tons. It reached a maximum of 675,000,000 tons in 1918. Petroleum production in 1900 was 63,621,000 bbl., and increased to about 760,000,000 bbl. in 1925.

The population of the United States was, in round numbers, 76,000,000 in 1900; it increased to 113,500,000 by 1925. The period was marked by the greatest immigration to the United States. Tremendous growth of the automotive, electrical, and chemical industries, apart from the mining industries, also characterized the period. Along with this, and one of the remarkable developments of the quarter century, was the general mechanicalization of all industries. This has greatly increased productive capacity. The growth of technical institutions, schools, and societies, in numbers and facilities, was likewise noteworthy. The federal Bureau of Mines was established in 1910 and furthered the safety movement, which has spread to all industries. Mining publications such as the *Engineering and Mining Journal* and the *Mining and Scientific Press* played an extremely important part in spreading information about mechanical appliances, improvements in mining and metallurgical practice, and the important developments in mining regions. Without this dissemination of information through the widespread circulation of the *Engineering and Mining Journal* and other technical journals it is highly probable that a smaller rate of progress would have resulted.

Turning to the principal general statistics available, the number of mining enterprises in 1902 totaled 45,858, the number of mines and quarries 17,039, and the number of persons engaged about 625,000; in 1919 the corresponding figures were 21,280 enterprises, 13,844 mines and quarries, and 1,088,189 persons engaged. The 1919 census returns contain no estimate of the capital employed in mining in 1902, but this in 1919 reached the total of $6,955,466,831; the comparative value of the products was $796,826,417 in 1902 and $3,158,463,936 in 1919. The penetration of the mining industries into the country as a whole is well illustrated by the accompanying figure, which indicates that only two states, Nebraska and Mississippi, produced mineral products of less than $1,000,000 per year in value, while three states, Pennsylvania, West Virginia, and Oklahoma, produced in excess of $200,000,000 or over, and six states, California, Texas, Minnesota, Michigan, Illinois, and Ohio, produced in



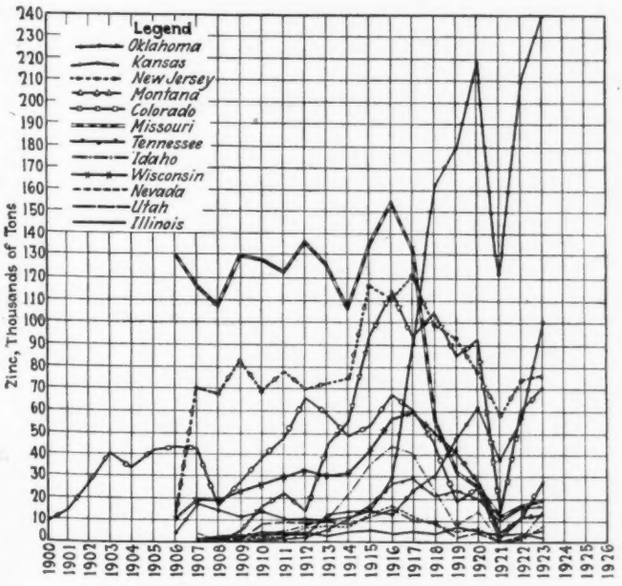
Lead production, by states (U. S. G. S.)

excess of $100,000,000. Without mining and the attendant industries dependent upon it for their raw materials it is a foregone conclusion that our material prosperity and present economic position would have been materially less than it is today.

Mineral discoveries are the keys by which mineral deposits are unlocked, but before commercial production eventuates, exploration and development are necessary, brains, capital and experience being essential accessories. Although many known mining districts were extended during the period, a number of new discoveries were made. The discoveries of gold in the Klondike and at Nome, followed by the discoveries at Tonopah and Goldfield, were important events in that, as has been said, they marked the beginning of a wave of mining interest. Cobalt, Ont., was discovered in 1904; Fairview, Nev., 1905; Manhattan, Nev., 1905; Oatman, Ariz., 1906; Rhyolite, Nev., in 1907; Jarbidge, Nev., 1909; Porcupine, Ont., 1910; the Flin Flon mine, Manitoba, in 1915; the Premier mine, in the Portland Canal area, B. C., in 1917; Divide, Nev., 1917; California-Rand, Calif., 1919; Gilbert, Nev., 1924. The foregoing list is not exhaustive and merely enumerates names that occur to me.

The advent of the "porphyry coppers" began with the operation of the Magna mill in the spring of 1907, although preliminary milling work had been started in 1904 in Bingham Canyon by D. C. Jackling and his associates. In 1908, the Nevada Consolidated, at Ely, Nev., made its first production. The Miami mill was started in 1911, as was also the Ray Consolidated mill at Hayden, Ariz. Chino started mill construction in 1911. The Inspiration mill went into operation in 1915. New Cornelia, at Ajo, Ariz., started its leaching plant in 1917. Steam-shovel mining was initiated at the Utah Copper, at Nevada Consolidated, at Ajo, and at Chino, and underground mining at Miami, Ray, Ruth, and Inspiration. The initiation of large-scale operations predicated on drill-hole and underground exploration, experimental milling campaigns, and under a well-thought-out engineering program was successful in a large way and did more to establish good engineering firmly as a feature of modern mining than any other example, although the Alaska Treadwell and Homestake operations had already served as an inspiration and an example of good engineering and careful management.

The confidence engendered by the success of the porphyry coppers led some engineers to project similar methods into gold mining, and Alaska Gastineau and Alaska Juneau, two low-grade gold properties near Juneau, Alaska, were financed and started, Alaska Gastineau early in 1915 and the Alaska Juneau in 1917. Neither achieved success, and the former was shut down in 1921 and the latter was drastically reorganized and is being continued. Changes in economic position resulting from the war, dilution in



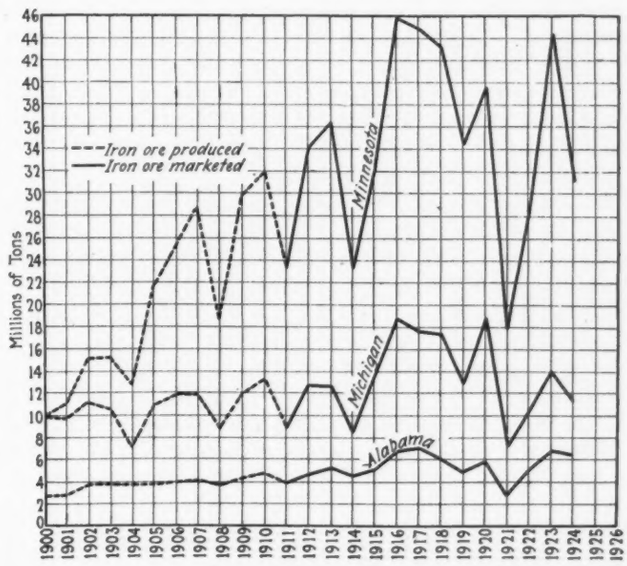
Zinc production by states (U. S. G. S.)

mining or failure to realize anticipated values, faulty mill construction in the instance of the Alaska Juneau, and other less direct reasons have been given for the failure of these properties. Nevertheless, the experience with them has materially advanced mining knowledge. Taken in conjunction with the porphyry coppers, knowledge of the nature of disseminated low-grade metalliferous deposits and methods of exploitation have been greatly advanced.

At the beginning of the present epoch, applications of electrical power in mining operations were spreading. Hydraulic power was discarded, although both pumping and hoisting operations were in a few instances effected by these power agents, but steam and compressed air displaced hydraulic power and in turn in some places were displaced by electrical power. Probably no other factor has been so important in the development of modern mining and reduction plants as electrical power. Compressed air had its day, and still continues for rock-drill and small hoist operation, where its convenience is a more important factor than its mechanical efficiency. Development of hydro-electric power plants, transmission lines, and electrical apparatus generally has simplified the design and operation of mine plants, mills, shops, and smelters. Electricity lights the mines, operates the pumps, hoists, ventilating fans, locomotives, and compressors and is applied wherever power is required except as noted. One of the first Diesel engines was installed at the Midway mill, Tonopah, Nev., in the early history of the district. Of late years the Diesel engine has found extended use in mining operations where hydro-electric power is not available.

Mechanical Appliances and Mining Methods

The inventor and his assistants, the technical man and the manufacturer, the underground foreman, superintendent, and the miner have improved both methods and appliances. Piston drills were available at the beginning of the period, but the miner was beginning to feel the need for lighter and handier drilling tools and was experimenting with "baby drills" in stoping. The hammer type of drill with hollow drill steel was invented by J. G. Leyner in 1897, but it did not become established until some years later. Beginning with 1905 it rapidly displaced the piston drill and is now almost exclusively used. The stoper drill was introduced in 1906 and the jackhammer or small hand-held type of drill in 1909, but this did not come into general use until 1912. Rotary drills and electric rock drills were tried out but disappeared. However, a type of hand-held drill with extra strong rotation was developed and is used for drilling soft formations. Rotary



Production of iron ore by states (U. S. G. S.)

drills persisted in coal mining. Although compressed-air-operated hoists for underground use were more or less common, the period developed a compact air-operated hoist for stope and raise service and in heavier forms for scraper operation. A corresponding type for electrical operation has also become established. Drill sharpeners were introduced about 1907 and have been developed in recent years, becoming thoroughly established.

Introduction of Underground Loading

Great attention has been given since the war period to underground loading by mechanical means, with the objective of eliminating hand shoveling, and a considerable degree of success has attended efforts to improve loading efficiency. Several different types of mechanical loaders are now available in coal and metal mining. The power-drawn scraper has established itself in metal mining where conditions are suitable for its use. Additional progress is expected.

Electrical locomotives for underground transportation, both of the trolley and storage-battery types, are now used in large-scale and even moderate-scale operations. Compressed-air locomotives are also used in coal mining and in metal mining. In quarry operations, gasoline locomotives are used to an increasing extent, especially in small, detached operations. Roller bearings are now an established feature of mine-car construction. Mechanical ventilation has displaced natural ventilation in many metal mines and is now an accepted feature of metal mine operation. Electrically operated pumps, both of the reciprocating and multi-stage centrifugal types, have displaced steam- and air-operated equipment. Electrically operated hoists have largely displaced and continue to displace steam-operated engines. Skip hoisting has become a feature of practically all large metal mines. Provision for cage hoisting in separate compartments is common practice.

Mining by Undercut Caving Developed

Mining of veins and thin lodes does not show a material advance in methods except in those few instances where scrapers have been introduced to reduce the number of ore passes or to facilitate ore and waste handling where the deposits are too flat for gravity movement. The greatest development in mining methods has taken place in the mining of large orebodies of the type represented by the porphyry coppers. Methods originating in the iron-mining districts of Michigan were adapted and improved, until finally the undercut-caving system was originated. Multiple shrinkage stoping with the mining of intervening pillars by a retreating system was also developed, but this gradually worked into a modification of undercut caving. The alternative method is top slicing, which is generally used where conditions are not favorable to undercut caving. Sublevel caving is also an alternative method. Top slicing and sublevel caving have been improved by the use of scrapers for ore movement.

In open-pit mining the steam shovel maintained its supremacy until a few years ago, when the electrically operated shovel was introduced and gave greater economy. The continuous-tread mounting was also introduced in the comparatively recent past, and this type, being more mobile than the railroad type of mounting, dominates the present situation. Long-boom shovels for use in stripping and back-filling have proved to be useful under special conditions. They were introduced about fifteen years ago. Air-dump cars, spreaders, and track shifters were also developed and are important accessories to open-pit operations.

Glory-hole mining was probably first used in the iron-mining districts; one instance, the Spanish mine near Nevada City, Calif., which was described early in 1900, has been advanced to an important method for both ore mining and quarrying in general where the deposit is of a suitable nature.

Continuous-Bucket Dredging Perfected

The development of the continuous-bucket dredge in the gold-dredging districts of California is a story in itself. Electrical power made possible a compact, workable arrangement of the machinery upon the hull. Remarkably low costs of excavation were obtained. The introduction of manganese steel for buckets, bucket lips, bushings, and wearing parts generally was the means of broadening the market for this alloy, which has established itself wherever excessive wear and severe operating conditions have to be met.

Air-compressor design was greatly advanced in the period. The introduction of the plate valve first used in the Leyner compressor was the forerunner of improved valves. Again electrical power was an important influence leading to the compact, high-efficiency machine of the present day. Portable compressors operated by internal-combustion engines are now supplied for prospecting operations and have made possible economical exploration of scattered areas.

Crushing and Grinding Machinery

Gyratory and Blake-type rock crushers were improved in design and mechanical construction during the period. A fine reduction crusher of the gyratory type is now commanding attention. The important invention of the period was the disk crusher, which has earned a place for intermediate crushing. Crushing rolls were also improved in design and are now greatly used for intermediate work. In fine grinding, the Chilean, Huntington, and similar mills have almost disappeared, being supplemented by ball and rod mills. The tube mill, introduced early in the period, continues to hold its place where very fine grinding is necessary.

Stamps are still used in gold mills, but the ball and rod mills are slowly displacing them.

Classification and Dewatering

The investigative work of Prof. R. H. Richards in classification featured ore-dressing literature of the period, and many devices involving free and hindered settling were developed. It is of interest here to note that principles of hindered settling are now being applied to coal cleaning. Dewatering cones and hydraulic classifiers are still in use. The rake classifier and others of similar principle used for tube-mill work found further application in ball- and rod-mill grinding. Continuous thickeners and water-conservation appliances early found favor and were the pioneers in this useful equipment.

Separation and Concentration Appliances

Jigs, tables, and vanners were the standard separating appliances at the beginning of the period. For slime concentration, various modifications of the bud-

dle were applied, and a concentrating system involving crushing, sizing, and classification in stages with accompanying separation was built up and became firmly established.

Flotation, introduced in 1910 from Australia, changed accepted methods fundamentally. First applied as a supplementary process, it soon satisfied the field for slime concentration to the exclusion of various slime tables and buddles. Within the last few years "all-flotation" has invaded the copper and lead-ore field, and both jigs and tables have been displaced to a marked extent. Selective flotation as applied to lead-zinc ores and to copper sulphide-pyrite ores is a more recent extension of the field of the flotation process. The most important event of the quarter century in ore dressing was the introduction of flotation. Whether it will supplant jigs and tables altogether, remains to be seen. With the flotation process an interesting development of flotation machines has taken place, the most important appliance other than the original mechanically agitated cell being the pneumatic or porous-bottom flotation unit. Other types of machines involving both mechanical and air agitation are features of comparatively recent development. Xanthate, a flotation reagent, was only recently discovered and applied. The sulphidizing of oxidized lead ores and their successful flotation was also a comparatively recent development. Whether oxidized copper ores can be successfully handled is one of the present problems awaiting solution.

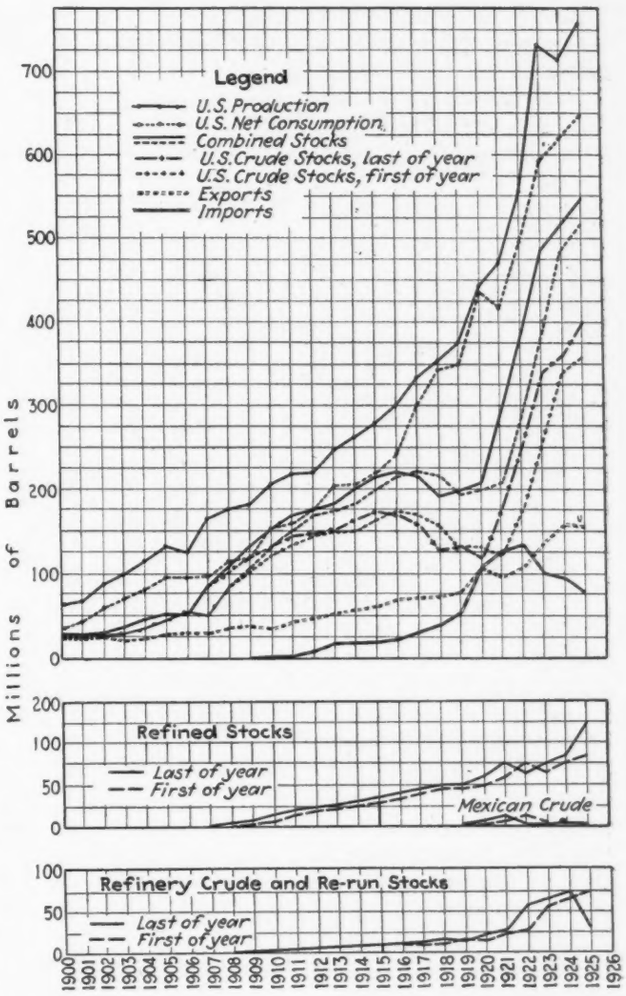
Early in the period, lead-zinc-iron ores were successfully handled by table concentration followed by magnetizing roasting and magnetic separators. This method sufficed for a number of years and was the means of affording a commercial outlet for the complex ores of a certain type. Selective flotation now competes with this process and has displaced it in several important instances, notably the one at Kimberley, B. C. However, magnetic separators were introduced into iron-ore beneficiation, and their application by the Mesabi Iron Co. at Babbitt, Minn., indicates an important field. Another important use for magnetic separators which is now a feature of standard practice in all crushing plants is their use for removing tramp iron.

Electrostatic separators were for a number of years used for the separation of zinc-iron concentrates, and served the purpose excellently, but, as in the case of the magnetic separators, selective flotation invaded the field, and their importance is diminished.

Apron feeders and speed reducers are important mechanical accessories, which have found numerous applications in milling plants within the last few years. At the beginning of the period, the revolving trommel was the most important sizing machine, but the belt screen was developed for fine-sizing wet julps, and various types of impact and electric-vibrating machines for both dry and wet pulps were perfected and have become established as standards where sizing is necessary. The bowl classifier is still another device that has won a distinct place for handling fine pulps.

For a time there was an important development in dry concentrators of various types, but this field has now become unimportant compared with other methods of separation.

Cyanide and chlorination competed for the treatment of gold and silver ores at the beginning of the period. The introduction of the McArthur-Forrest cyanide process at the close of the last century was one of the epoch-making events in gold and silver metallurgy. It broadened the mining field greatly and made available


Legend
U.S. Production
U.S. Net Consumption
Combined Stocks
U.S. Crude Stocks, last of year
U.S. Crude Stocks, first of year
Exports
Imports
Millions of Barrels
Refined Stocks
Last of year
First of year
Mexican Crude
Refinery Crude and Re-run Stocks
Last of year
First of year
1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926

A graphic record of petroleum in the United States

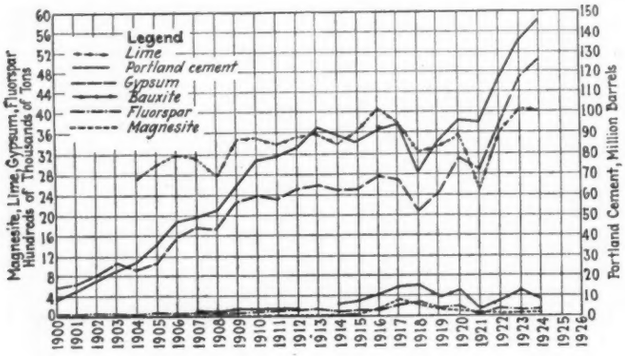
Production of petroleum in the United States from 1900 to 1925 has increased at an annual compounded rate of slightly over 10 per cent. The increase per capita of population from 0.48 bbl. in 1900 to 5.5 bbl. in 1925 is 11½ times the average net 1900 consumption per capita. The annual demand would add the excess exports to the net consumption. Compiled by Thomas Cox from U. S. G. S. and U. S. Bureau of Mines bulletins and reports of U. S. Department of Commerce.

for commercial exploitation low-grade ores and ores that could not be treated by amalgamation or that yielded indifferently to concentration. Tailings piles became workable, and many tailings plants were a feature of the beginnings of the period.

The Golden Gate mill, at Mercur, Utah, was the first large cyanide mill to handle the difficult ores of the Mercur district successfully. Chlorination was gradually elbowed out, although roasting practice and roasting furnaces became highly developed. Fine grinding in tube mills and cyanide treatment simplified the treatment of gold and silver ores. The slime problem arose early and was partly solved by decantation and by the use of filter presses. The filter-press treatment culminated in the development of special filter presses introduced by C. W. Merrill. However, Charles Butters developed the Butters filter at Virginia City, Nev., and

the Moore filter was introduced at Mercur and at Tuscarora, Nev. This was early in the period. Faulty mechanical design delayed the success of the Moore filter, but the Butters filter quickly won an established place and solved the slime-treatment problem conclusively. The all-slime plant quickly followed and is now a feature of cyanide practice. Certain plants used concentration and cyanide, but the all-cyanide treatment displaced this combination.

Experiments with the continuous filter finally led to the invention of the drum filter in 1909. A few years later this type of filter became established as an important adjunct in slime treatment. Counter-current decantation was introduced about this time, and for a while looked as if it would retrieve the field from filtration, but filtering appliances proved a necessary accessory and the modern plant makes use of both counter-current decantation and filtration. Different types of agitators were developed as accessories. Continuous thickeners also established themselves as part of the decantation appliances. Both thickeners and drum filters proved important accessories in the flotation process. It is an interesting fact to mention that successful slime filtration in the cyanide process solved also filtration problems in the chemical industry.



Production of magnesite, fluorspar, bauxite, lime, gypsum and portland cement in the United States (U. S. G. S.)

Precipitation of cyanide solutions introduced another technical development: The zinc-dust process supplanted to a large extent precipitation by zinc shavings, and the further development by Merrill of the Crowe and Halvorsen processes, the former providing for the deoxidizing of solutions before precipitation and the latter for regenerating cyanide, materially increased the efficiency of precipitation. Electrolytic processes were tried out early in the period, but did not secure a firm foothold. It is of interest to note that U. C. Tainton has recently developed another electrolytic process for cyanide solutions, which promises excellent results.

The relation of different processes is illustrated by oiling to inhibit the precipitating action of carbonaceous material in certain gold ores treated by the cyanide process. Thus the cyanide man borrows from the flotation engineer.

Hyposulphite leaching died out about the beginning of the period. Leaching with brine solutions was introduced at Anaconda and was also a feature of the Holt-Dern process, which was applied to silver-lead-copper ores after a chloridizing roasting in Holt-Dern roasting furnaces. The Holt-Dern process has been applied successfully in the Tintic district and elsewhere for silver ores not amenable to cyanide. Chloridizing roasting accompanied by volatilization is one of the more recent lines of research and is exemplified by the work of the Chief Consolidated Mining Co. in the Tintic district.

Copper Hydrometallurgy

Treatment of low-grade oxidized copper ores has long been a problem of the copper-mining industry. Hydrometallurgical treatment of copper ores by acid leaching and precipitation on scrap iron was known and practiced more or less, but the modernizing of wet-treatment methods belongs to this epoch. The Chuquicamata enterprise was brought to production in May, 1915, under the able direction of E. A. Cappelen-Smith and Pope Yeatman; New Cornelia in March, 1917; Utah Copper erected a leaching plant in 1917; Kennecott and the Calumet & Hecla in 1918; Inspiration is now completing a leaching plant, and several other Arizona copper companies have started heap-leaching operations. Sulphuric-acid leaching and electrolytic precipitation characterize the Chuquicamata and New Cornelia enterprises, although both are quite different in important details. The Utah Copper plant was an acid-scrap-iron plant. The Kennecott and the Calumet & Hecla plants employ ammonia solutions. Inspiration is planning to use ferric-sulphate solutions for the treatment of oxidized-sulphide ores. Weak sulphuric acids and water are used in heap leaching. Leaching of ore in place as at the Ohio mine is an interesting novelty. Quite recently the Pike process for the treatment of copper concentrates has been experimentally developed. Copper hydrometallurgy greatly advanced in this period and is now of fundamental importance to the copper-mining industry.

Zinc Hydrometallurgy

The first unit of the Trail, B. C., zinc hydrometallurgical plant was started in 1914, Guernsey, Stimmel, Lee, and Blaylock contributing their effort to the development of the process. The Anaconda plant at Great Falls was constructed in 1916, Laist, Frick, and Eaton dominating this development. Another plant was constructed at Park City, Utah. Although a plant at Kellogg, Idaho, is projected, the aforementioned are the only three plants operated. Anaconda is now enlarging the Great Falls plant to 120,000 tons per year. Availability of cheap hydro-electric power has become a fundamental in the economics of this process, which is now of great importance.

Roasting and Desulphurization

At the beginning of the period, long-hearth reverberatory furnaces of the Jackling, Holthoff-Wethey, Ropp, and Brown types, and other mechanically rabbled as well as hand-rabbling furnaces, were in use for roasting and for desulphurization. Continuous-feed furnaces were displacing intermittent or batch furnaces, such as the Bruckner. The McDougall, the Herreshoff furnace, and the Pearce turret furnaces were in use, as was also the Evans-Klepetko furnace. The Wedge, a similar type, came later. The Merton furnace, a mechanically rabbled long-hearth reverberatory, was also a later type. Scanning the field at the close of the period

we note the extinction of many of these furnaces in copper and lead smelting; practically only the Wedge, Herreshoff, and similar types survive, and these are used principally in desulphurizing copper concentrates. The Merton appears to be the only type of long-hearth reverberatory in use outside of the zinc industry, where the Hegeler muffle furnace, consisting of superimposed hearths, is still employed, although other types, such as the Spirlet, have been applied in roasting zinc concentrates.

In desulphurizing lead concentrates, blast roasting eliminated the complicated hearth furnaces and was in turn eliminated by the Dwight-Lloyd sintering furnace, which now occupies the field for this work.

Copper Smelting and Converting

A better understanding of and a growing use of pyritic smelting was a feature of the beginning of the period. Blast-furnace smelting was important, but the increasing use of concentration was bringing the reverberatory into greater prominence. In 1909, E. P. Mathewson connected two contiguous blast furnaces by a third section at the Washoe plant and successfully operated the 51-ft. furnace resulting. Another furnace 87 ft. in length was constructed. This marked the culmination in the use of copper blast furnaces. From this time on the copper blast furnace became of less importance, although still used. The reverberatory furnace now dominates the situation. A marked increase in the size of reverberatories and an improvement in accessories and design are present-day features. The latest reverberatory constructed in 1925 measures 34 by 134 ft. in inside dimensions and is equipped with three 860-hp. boilers placed in parallel. Litigation on reverberatory furnace patents culminating in the latter part of the period may have an important influence in stimulating the development of fundamentally different methods for the treatment of fine copper concentrates.

Converter practice at the beginning was predicated on the acid-lined converter and practice was highly developed. The Peirce-Smith basic-lined converter had its beginnings in 1906, and in the course of a few years displaced the acid converter. The practice of smelting both raw ore and concentrates in the converter is now a feature of basic converting. The size of the converter has grown, and two designs, the Great Falls and the Peirce-Smith cylindrical type, now dominate the field. The large Peirce-Smith, 12 by 30 ft., has a capacity of 2,500 tons of copper per month.

Slag-casting machines were used at the beginning and have since been perfected. Blister-copper casting machines are also used, the circular Walker type and the straight-line casting machine being now generally adopted. Traveling cranes and accessory machinery for handling materials have likewise been perfected.

Lead Smelting

Mechanical charging of lead blast furnaces was well established at the beginning of the period. Few fundamental improvements other than those made in details of design have been made in blast furnaces, and blast-furnace practice has been improved in minor details only. Better facilities for removing fume at tapping ends are now a feature of all plants. Flue and chimney construction advanced. Filtration of gaseous effluents by woolen bags, thus reducing metallurgical losses, represented the most marked advance.

Smelter-Smoke and Fume Troubles

Litigation arising from smelter-fume and smoke damage to surrounding farms featured this period. Improvement in height and design of smelter stacks was made to offset this difficulty, but the most significant invention was the Cottrell electrical precipitation process and its experimental development by Frederick G. Cottrell at Coram, Calif., in 1910. Since then it has become an established feature at most copper smelters and its use has extended to other industries.

Mechanical Handling of Materials

Early in the period Charles Butters installed in his cyanide plant at Virginia City, Nev., a conveyor system for charging and Blaisdell apparatus for discharging leaching tanks. There was at the time extended use of belt conveyors, but this feature of the mechanical handling of materials is now standard in all plants of any size. The Messiter system of ore bedding and reclaiming was installed at Cananea in 1907 and later at several smelters. At the International smelter at Miami and at the Tacoma smelter a belt-conveyor bedding and reclaiming system is in use. Similar systems have been generally evolved. Locomotive cranes and steam stovels have been utilized by both the smelter and the millman for either special or miscellaneous service. Car unloaders are a feature of some of the larger milling plants.

Welfare, Health, and Compensation

The period shows marked improvement in labor, living, and general welfare conditions. The condition of the worker both in his home surroundings and in the mine and surface plants has been improved. Wages have increased. Safety and first-aid work, by enlisting the active co-operation of the workers, has made in numerous instances a reduction in the number of accidents. Various publications have played a part in the movement. The Bureau of Mines has justified its existence by its leadership in this field. Industrial compensation laws have improved the status of the injured worker. Industrial hazards are better understood and industrial accident insurance has become an established feature.

Position of the Technician

Although the period witnessed a great growth in the technical schools and a corresponding output of graduates, the position of the technician appears not to have greatly improved, but, on the contrary, to have retrograded. This became more apparent in the period following the war, when many were forced to change their field and to go into other lines of endeavor. Consulting practice continues, and many men are successful no doubt; but greater ability, both technical and business, is required now to establish a foothold in consulting practice. Consolidations of mining companies into larger units have still further reduced the opportunities in the consulting business. Operating positions are an important outlet for the technician and will continue to be so. Promotion and initiatory mining operations are other outlets which attract the capable man and which offer perhaps greater monetary rewards.

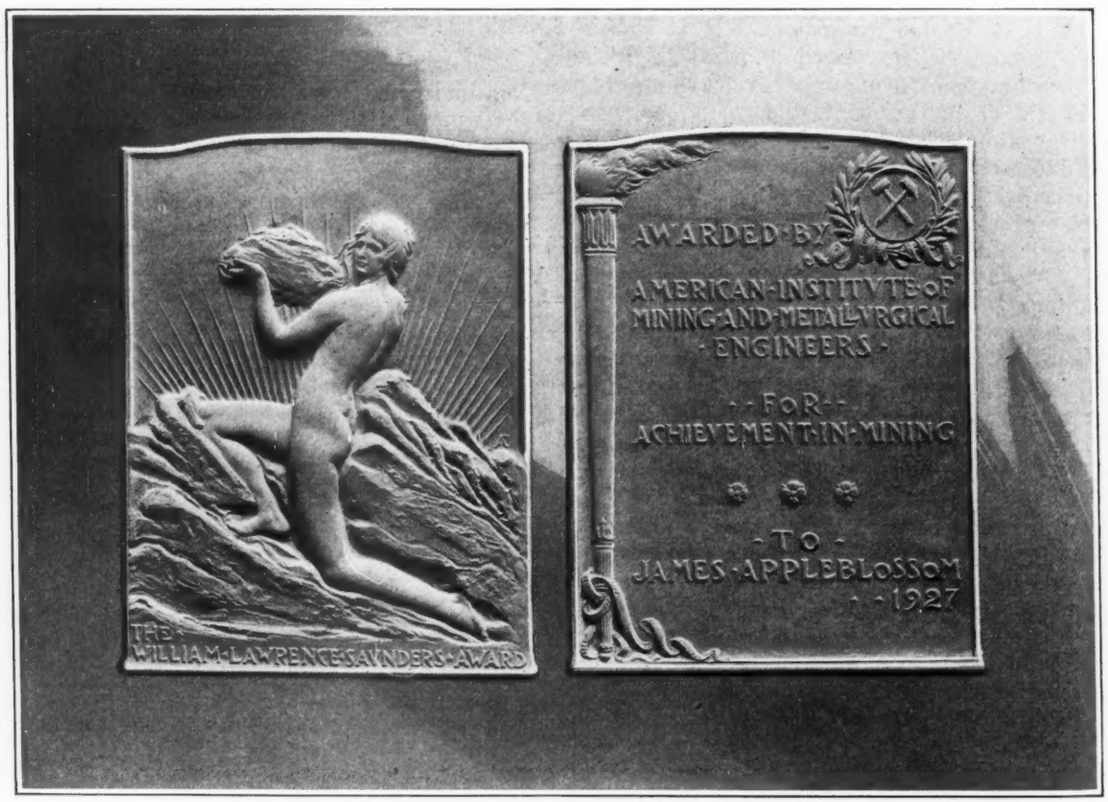
As to the future, the really capable man who unites technical knowledge and experience with business acumen will find in the mining industries plenty of scope for his abilities. The raw graduate, at the other extreme, will find plenty of minor opportunities, as has been the case in the past, but whether he advances in the mining industries or leaves for other fields depends largely upon his own initiative and capacity for self-development.

The period as a whole has been marked by a substantial advance in geological knowledge and an increasing application of this knowledge to mining problems. The U. S. Geological Survey has played an important part in field observation, recording and publishing the geological account of different mining areas. The consulting geologist has also occupied a prominent rôle. An important feature, one of the byproducts of the war period, is the appraisal of our mineral resources and a more quantitative understanding of the demands upon the mines and the probability of meeting these demands. As our civilization depends upon the maintenance of present production and a substantial increment, the greatest present problem appears to be more mines. It takes an appreciable time to bring a mining property into production, and it is feared by some that without a greater number of new and promising mines our metal product will not be maintained.

The passing of the old-time prospector is deplored by some. Others are pessimistic as to the probability of finding new mines in our mining areas that have already been repeatedly prospected. Old mining areas have been reopened and explored, but without much commercial encouragement. New methods of prospecting have been proposed and the instrumentation of prospecting is in progress.

Electrical prospecting has recent become a much-discussed subject, and a number of tests have been made and some success has been recorded. The petroleum geologist has also been active in devising instruments to further his work of prospecting. All this is an interesting commentary on human ingenuity, which may be depended upon to ultimately find a fair proportion of the "blind" deposits, and, failing to do this, to devise substitutes for the metals that can no longer be produced in quantities to meet the demands. The rise of the aluminum industry, the production and utilization of magnesium, tungsten, molybdenum, chromium, and vanadium are instances of the virility of industrialists in adapting new metals. The cracking process in the petroleum industry exemplifies an advance in synthetic chemistry. Increased recoveries and the utilization of waste products will continue to feature technical progress.

The transition of the mining industries to an international basis which characterizes the past decade is significant in that the cumulative mining, manufacturing, and business ability which is the resultant of the progress of the quarter century is being used for the exploitation of mineral deposits in other countries as well as in our own.

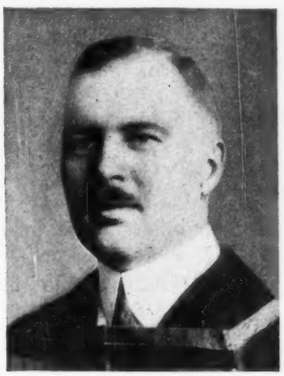


Design of the Mining Medal which the American Institute of Mining and Metallurgical Engineers has established in honor of William Lawrence Saunders, Past President. Anthony de Francisci is the artist, and his creation is intended to represent "Mining Science Bringing the Ore to Light." The name "James Appleblossom" is fictitious

Rock-Drill Lubrication

How to Select the Proper Oil—Viscosity and Cold Tests Important but Indicative Only—Color and Specific Gravity of No Value

By I. M. Marshall
Assistant Professor of Mining Engineering, University of Illinois, Urbana, Ill.



I. M. Marshall

IN THE SELECTION of a rock-drill lubricant, a mine superintendent, though quite willing to be guided by the advice of the manufacturer, may find that the oil or oils recommended cannot be procured in his remote district, or, if procurable, are too expensive to use. Should he not realize the value of a suitable oil, he may conclude, "Maybe castor machine oil is about as good as any," and give it no more thought. Many mining companies use castor machine oil for this purpose, and claim at least a moderate degree of success. It cannot be recommended, however, as it may vary considerably in consistency and body and may lack the property to remain fluid at low temperatures.

Of all the oils ordinarily kept in stock at a mine, few are suitable for rock drills. Nor is it advisable to recommend widely any one oil for use in all mines. The oil that is suitable will vary with several things: first, the type of drill used; second, the degree of moisture in the air; third, the air pressure; fourth, climatic conditions. No matter what the conditions may be, however, the oil should respond favorably to certain definite tests. Therefore a mine superintendent in preparing his specifications may feel more confident if he has a knowledge of those tests. It would be well, too, if he should recognize those having little or no bearing upon his selection.

Color of Little Importance

Except to a chemist, neither color nor specific gravity has any value in determining the most suitable oil for use in rock drills. Being light or dark may mean almost anything, and any one of two oils of the same specific gravity may or may not be a good choice. The only possible use the knowledge of the specific gravity of an oil (usually given in degrees Baumé) can be put to is in checking quantities if quoted by either weight or volume. Neither is the flash nor the fire test of any help, although usually stated in the specifications for steam-cylinder oils. To a fire-insurance company, however, the flash point of an oil stocked by a mining company may prove of interest.

Viscosity is a necessary feature of any specification. The common conception of viscosity is body or thickness. More strictly speaking, it is the measure of internal resistance, and is calculated by means of a viscosimeter, the Saybolt type being the one most commonly used in the United States. With the Saybolt viscosimeter, the oil to be tested is placed in a covered oil cup of determined size and shape, fitted with a standard orifice and valve. The cup rests in a bath of water or oil, which is heated to the desired temperature. At this temperature the oil is run into a 60-c.c. flask. The time required for the delivery of 60 c.c. of the oil is stated as its viscosity. For lubricating oils this is expressed in seconds at 100 deg. F. or 212 deg. F.

Besides the viscosity test is another of equal, if not greater, importance—the cold test. Strictly speaking there are two definitions of cold test—namely, cloud test and pour test. Some oils contain substances which will separate at a definite temperature without the oil losing its fluidity. The temperature at which the separation is first apparent is called the cloud test or chill point of the oil. The pour test is given as the lowest temperature at which the oil just ceases to flow. It is necessary in reporting cold test that there be no confusion between cloud test and pour test.

Specifications for a drill lubricant should call for an oil of fairly heavy body, not wholly from the viewpoint of lubrication but more from the point of view of economy. An oil too light in body will feed too fast, and either a larger quantity will have to be used to insure proper lubrication or unnecessary wear will result due to the oil blowing through the machine, leaving the reservoir dry. An oil too heavy in body will not feed fast enough, and the same unnecessary wear will be the result. It is suggested that the viscosity be stated between the limits of 350 and 500 seconds Saybolt at 100 deg. F.

In warm climates and with high pressures the heavy-bodied oils will be found more satisfactory for drills of simple design; in colder climates the lighter-bodied lubricants of viscosity approaching 350 seconds will be found more satisfactory. In open-pit operation under severe temperature conditions this figure will have to be greatly reduced. As the expansion of air in pneumatic machines produces low temperatures, it is most important that the lubricant should have a good 0 deg. to 5 deg. cold test. It should possess also the following properties: First, that of atomizing well with air; second, of emulsifying with water; third, of being acid resisting, if mine water is used in the machine; and, fourth, of showing no tendency to stiffen at temperatures near 30 deg. F., in order that the drilling speed may not be reduced. To obtain good emulsifying properties it is desirable that the oil be compounded with an animal, fish, or vegetable oil. Rapeseed oil has been considered the best emulsifier, but, because of its high cost, it is doubtful if an oil compounded with any appreciable quantity of rapeseed can be recommended. Here, price will be a determining factor. Practically all liquid greases will meet the specifications mentioned; that is to say, they are all compounded mineral oils having a pour test of about 5 deg. F. and a viscosity between 350 and 500 seconds Saybolt at 100 deg. F.

These Tests Indicative Only

The physical tests described can be termed indicative, but cannot be considered absolute. The only reliable method of testing a lubricant is to try it in actual practice. If there is any doubt in the superintendent's mind concerning his lubricant, it is suggested that he ask himself the following questions: Is piston or cyl-

inder scouring common? Are rotation part replacements excessive? Do the moving parts of a drill show clean, bright surfaces after days of idleness?

With the purchase of a suitable oil the problem of lubrication is only half solved. There must be the assurance that there is a continuous flow of oil to the cylinder. This is a point that should be stressed with all underground officials. The mine executive who realizes the importance of having a suitable lubricant, properly applied, has taken a big step toward maximum efficiency and minimum drill-part replacements, which will result in long drill life and decreased operating costs.

Until recently all drills were made with a small oil reservoir and a "heart-beat" oil feed as an essential part of the drill. Several rock-drill companies now manufacture a comparatively new oil device, which consists of a separate reservoir connected in series with the air line. The oil is atomized and fed to the machine with the air. Its chief advantage is that it requires filling only once a shift; whereas, the drill reservoir requires filling much more often. The new air-line oiler will bring improvements also in rock-drill construction. It will permit of simplified design and decreased weight by the omission of the oil reservoir as an essential part of the drill. Already one manufacturer has taken advantage of this in a new drill which was placed on the market recently.

Utilization of Black Sand as an Iron Ore in California

Black sand (magnetite), accumulated on the ocean beach near Aptos, Santa Cruz County, Calif., is utilized by the Triumph Steel Co., of San Francisco, in making sponge iron, alloy steel, and briquetted magnetite, according to the California State Mining Bureau.

Research and experimental work on the black sands has been carried on for several years. Originally a red iron-oxide paint pigment was produced. Later the plant was expanded and the direct production of sponge iron from magnetite begun. The company owns a site of five acres and 1¾ miles of adjacent beach. The process of reducing the magnetite is patented, and much of the apparatus in the unit in operation is of original design and manufacture.

At Aptos, the gray-black beach sand is taken by a drag-line scraper, operated by an electric hoist, and delivered to a bin feeding an elevator. The elevator delivers the sand through a screw feeder to a rotary oil or gas-fired kiln, which is used as a drier. After passing through this rotary, the thoroughly dry sand is run to another elevator, which discharges into a revolving screen at the top of the plant. This screen, which is about 12 mesh, removes all pieces of shell and coarse gravel, which go to the dump. The fine sand discharges to a hopper feeding the specially designed magnetic separator. This machine consists of a series of horizontal troughs mounted on a frame standing at an angle of about 80 deg. from the horizontal and reaching from the lower floor to an elevation of about 40 ft. The sand from the hopper at the top is distributed in a thin film over the top trough and falls by gravity from top to bottom of the separator. In dropping from one trough to another, it passes over magnetic fields of various intensities designed to remove the separate constituents. Practically all of the magnetite is obtained in the first four troughs. As the sand flows over these, the circuit to the electromagnets is automatically broken three times per second, pulling out and dropping the magnetite into a compartment. As the sand continues to cascade over the remaining sectors, the ilmenite and chromite are segregated by regulation of the magnetic fields, each going to separate bins. The quartz, garnet, and other minerals constitute the tailing, which is discharged.

Either pure magnetite, or a combination of magnetite with ilmenite or chromite, as desired, is then elevated and fed to a special revolving electric-heated muck-bar tube or kiln, approximately 3 ft. in diameter and 35 ft. in length. The lining of this tube has nichrome heating elements imbedded, connection being made by two annular copper bands at each end, which revolve with the tube and dip in mercury troughs. Crude oil is sprayed into the feed end of the hot tube as the magnetite passes through it. The oil does not burn, but is immediately gasified, the gases reducing the iron oxide to a metallic condition as sponge iron. The sponge iron is discharged at the lower end into a briquetting press, which delivers the muck-bar billets ready for the market. Gases from the muck-bar tube are drawn off and go to a dephlegmator, which extracts crude oil from them, and delivers an excess of carbon monoxide gas, for use under the boilers, or drier.

A large amount of direct electric current is used, four days being required to bring the muck-bar tube up to operating temperature after a shut-down. All electricity is generated at the plant, which is equipped with a 500-hp. Babcock & Wilcox boiler and generators having a total of 2,000 hp. Only a portion of the latter are used in this unit. It is said that no other process will directly produce ferrotitanium.

The plant includes a machine shop, a laboratory, and housing facilities. Twenty-one men are employed. The full capacity of the present unit is 50 tons of muck-bar per day. An electric furnace for the production of alloy-steel is contemplated.

Development of this direct iron-reduction process has required considerable investment in plant and research. Metallurgically it appears to be workable, but its commercial and economic success has not as yet been definitely proved.

Floating Pyrite as a Waste Product

The flotation process is ordinarily employed to make a valuable concentrate for further treatment, but it may also be used to remove a sulphide that occurs as an impurity in other minerals not so readily floated. Such an unusual application of differential flotation has been made by Floyd Weed at the Gascho mine of the Universal Exploration Co., near Waco, Mo. The ore, which is lead-free, carries considerable pyrite, which separates fairly well from the jig concentrates, but which appears in large amount in the table concentrates. The slime is, therefore, passed through a flotation machine. A small amount of sodium sulphide is used, the zinc mineral sinking and the pyrite floating. The tailing is then sent to the tables, giving a concentrate much reduced in iron content.

The Red Lake Gold Area

District Known to Geologists Since 1872—First Prospected in 1898—Diamond Drills Testing Recent Discoveries—Not Yet Proven El Dorado

By Douglas G. H. Wright
Red Lake, Ontario

THE DISTRICT OF PATRICIA, in which the Red Lake gold area is situated, was formerly a part of the district of Keewatin, Northwest Territories, and was added by Act of Parliament of Canada in 1912 to the territory of the Province of Ontario. The area, which is to be described, lies at an altitude varying from 1,150 to 1,350 ft. above the sea.

Officials of both the Canadian and Ontario geological surveys have long appreciated the favorable geology of the Red Lake basin. In support of this the opinions of some of those intimately associated with the early mapping and exploration of the area are given below. The first mention of Red Lake, geologically speaking, was made by Dr. Bell, of the Canadian Geological Survey, who visited the lake as early as 1872[1] and again in 1883.[2] Dr. Bell says:

"A very careful track survey was next made of Red Lake itself, as its shores proved to be of great geological interest. The whole lake (which is of considerable size) lies within a wide belt of Huronian[3] rocks, among which several of the rarer varieties are well developed, and they were found to contain some interesting minerals."

The late Dr. D. B. Dowling,[4] who explored the Red Lake basin during the summer of 1893, mapping the granite areas and differentiating them from the "Huronian series of schists, limestone, and altered traps" with such accuracy that his maps and observations have only recently been fully appreciated, stated in his report as follows:

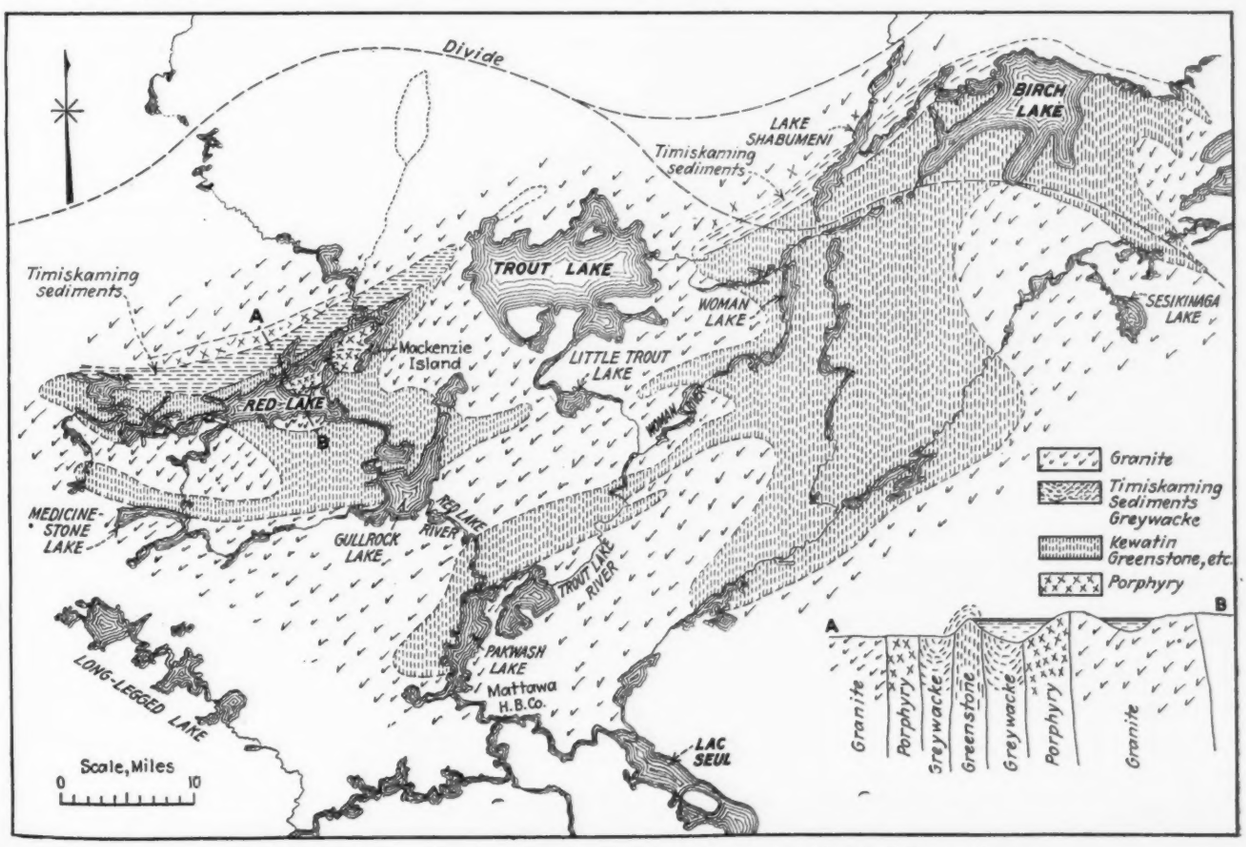
"In the country under consideration the rocks exposed are all Archean, consisting of gneisses and associated granites, classed generally as Laurentian,[5] and folded schists and greenstones of the Huronian. In many respects these rocks are the counterparts of those found in the districts further south on the Lake of the Woods and Rainy Lake. . . . The Laurentian gneisses are the prevailing rocks of the whole region, and their association here with folded schists, greenstones, and rocks of apparent sedimentary origin is of special interest in view of the auriferous nature of many of the quartz veins cutting similar rocks in the vicinity of Rainy Lake and Lake of the Woods."

The late Dr. Willet G. Miller[6] expressed his faith in the future of the District of Patricia as a mineral producer. He stated:

"Little detailed geological work has been done in the district. The parties that have visited it have confined their attention practically to water-courses. In so far as can be judged from what is known of the geology, the district should contain important mineral deposits."

Red Lake truly seems to be an instance where the

[1] Report of Progress, Geol. Sur. Can. for 1872-73, pp. 8-18.
[2] Report of Progress, Geol. Sur. Can. for 1882-83-84, p. 5.
[3] Most of the rocks classed as "Huronian" by the early Canadian geologists are, under the nomenclature now in use, called "Keewatin."
[4] Geol. Sur. Can. "Report on the Country in the Vicinity of Red Lake." D. B. Dowling.
[5] Most of the rocks formerly classed as Laurentian in Ontario have of late been found to belong more properly to the Algoman.
[6] Ont. Dept. of Mines Report, Vol. XXI, pt. II, 1912, By Willet G. Miller.



Red Lake Area, showing approximate outline of geological formations

geologist fulfilled his mission—in finding the "haystack" —and the prospector his in finding the "needle." It now remains for the mining interests to prove up the discoveries already made while the search continues for more "needles." The field is one of favorable geology where several discoveries of gold have been made, only one of which at the time[1] of writing is of even possible economic importance. The extensive area has never been prospected, and it seems extremely probable, with the concentration of prospectors in the area during the summer of 1926, that important discoveries will be made.

Accessible by Small Boats in Summer

In summer, Red Lake is most easily reached from Hudson, Ontario, on the Canadian National Railway, about 250 miles east of Winnipeg, Manitoba. From Hudson, fair-sized motor boats may be used as far as the outlet of Lac Seul at Pine Ridge. From Pine Ridge smaller motor boats or 17- or 18-ft. canoes with outboard motors are recommended. From Pine Ridge the English River is descended as far as the mouth of the Mattawa River, in which distance two quite short portages are necessary to pass Upper and Lower Ear Falls. The Mattawa River is ascended to Shallow (Pakwash) Lake, at the north end of which Red Lake River enters. This stream is followed up to Red Lake, the route crossing Gullrock Lake and Keg Lake. Four portages are necessary between Shallow (Pakwash) Lake and Gullrock Lake, all of which are short.

The route into the eastern extension of the Red Lake area in the vicinity of Woman and Birch lakes leads off from the Red Lake route in the northeast bay of Shallow Lake. Trout Lake River is ascended to Little Pakwash (Bruce) Lake, which is traversed to the inlet of Trout Lake River. Trout Lake River is again ascended to the junction with Woman River, which is followed northward through Snake, Little Bear, Cedar, and Woman lakes, all of which constitute widenings of the river. Several short portages are necessary.

Airplane service has been established from Sioux Lookout by the Patricia Airways & Exploration Co. and from Hudson by the Elliott-Fairchild Air Service.

Supplies, Mail and Telegraph

Complete outfitting supplies are available at Hudson, Sioux Lookout, Pine Ridge, and Red Lake. Swain, an independent fur trader, has a stock of supplies at his store on Woman Lake portage, for those proceeding into the Woman and Birch Lake areas.

A post office has been opened at Red Lake on the west shore of Burntwood Bay. For those proceeding into the Birch Lake country mail should be addressed care Hudson Bay Co., Pine Ridge Post, via Rolling Portage P.O., Ontario, Canada.

The Canadian National Telegraphs has a commercial office at Hudson and Sioux Lookout; by the payment of 25c. additional, telegrams can be delivered at Red Lake the same day that they are received. Telegrams can also be broadcast through broadcasting station CKY, Winnipeg, Manitoba, at 12:45 p.m. and 5:45 p.m. daily.

Topographically, the Area Is of Low Relief

Topographically this area is a low, undulating peneplain studded with numerous lakes and rivers, mostly post-glacial. The maximum difference of relief from the lake bottoms to the tops of the ridges is rarely in excess of 300 ft. The hills rarely rise more than 150 ft. above the lake levels. Apparently the highest elevation is 1,450 ft. along a range of hills between Woman and Birch lakes. Lacustrine clays largely fill the lower portions in the rock floor and support a splendid growth of poplar, spruce, balsam, jack pine, and birch. These species all grow to a large size and are suitable for timber and pulpwood.

Fire has not destroyed much timber and it behooves everyone traveling in the area to "Protect the Forest," for its value is sufficiently great to surpass even the mineral resources. It is doubtful if gold mining alone would support a railroad, but with the immense timber resources of the area intact the development of the mineral and forest resources combined should in time justify the construction of rail transportation facilities.

In some parts of the area rock ridges are small and scattered, but in most of the gold-prospecting area along the shores of Red Lake bedrock is fairly well exposed, and character identifications are thereby readily made. A shallow to locally deep overburden of lacustrine stratified clay and sand occupies the hollows and valleys between rock ridges, which will retard as well as increase the cost of prospecting the area. Muskeg areas are usually not large.

Ample Water-Power Available

An ample supply of undeveloped water-power is available within forty-odd miles of the Red Lake basin. The two most important sites for power development are (1) Upper and Lower Ear Falls, on the English River below Lac Seul; these at 80 per cent efficiency make available 10,176 hp. at minimum flow and 14,763 hp. at ordinary six months' flow. (2) Manitou Chute, Upper and Lower Manitou Falls, which have combined an estimated capacity in horsepower at 80 per cent efficiency at ordinary minimum flow of 20,583 and of 28,157 at ordinary six months' flow. A general comparison of installed power with estimates of available power shows that throughout Canada under present-day conditions the actual water-wheel installation is about 30 per cent greater than corresponding ordinary six months' power.

The large proportion of lake area in the drainage basin in which these undeveloped water-powers are situated produces a run-off which is extraordinarily uniform and greatly enhances the power-producing possibilities of these sites.

Climate and Agricultural Possibilities

The climate is in all respects similar to that in other parts of northern Ontario where at present mining operations are carried on the year around without interruption.

The clay soil which covers a large part of the area will easily support agricultural products, which fact is important locally in connection with mines and other industries that may be established.

A splendid garden is kept at the Hudson's Bay post, Red Lake, and the resident manager, William Smith, says that all sorts of garden vegetables reach maturity during the summer months.

No data are available with regard to rainfall and snowfall.

The first prospecting in the area probably followed

[1] Red Lake, Ontario, April 15, 1926.

closely the publication of Dr. Dowling's report[8] upon the area in 1896. A group of British prospectors operating under the name of Northwestern Ontario Exploration Co., Ltd., staked a number of claims inland from the north shore of Slate Bay. Several rather pretentious camp buildings and an assay laboratory were established on the lake shore and work continued during the winter of 1897-1898. Assays of ore samples obtained by J. W. Tyrrell[9] ranged in gold values from $2.60 to $12.50 per ton. Lack of adequate transportation facilities hampered operations.

From 1898 to 1922 there is no evidence that any search for mineral deposits was carried out in the area except some stakings during the war on promising auriferous quartz veins in the country west of Birch Lake. In 1922 exaggerated press reports brought a small influx of prospectors to the lake under the impression that silver had been found under conditions similar to those existing at Cobalt, Ontario. A number of claims were staked, but practically no prospecting was done. One party, headed by Gus McManus, of Hearst, Ontario, recognized the probable geological setting for the occurrence of auriferous deposits and accordingly prospected for gold rather than silver, with the result that some spectacular free gold was found in narrow irregular quartz veins on the north shore near the lake's outlet. McManus' description of the area was so interesting that the following year the exploration department of Dome Mines, Ltd., sent in a field engineer, and field parties have since been active there every season. In 1925 L. B. Howey, of Haileybury, working west along the strike of the McManus discovery, found a promising deposit which led to the present activity in the area.

FROM prospecting experience in northern Ontario the following are the most likely localities to prospect:

1. Along the limbs of the geosynclines not more than two miles remote from the axial region as denoted by the infolded Temiskamian sediments, particularly in proximity to Algoman porphyry intrusions.

2. In proximity to small outcrops of granite intrusive through the Keewatin which may be a cupola or top of a larger body beneath. Linear valleys indicative of shear zones or regional faulting are worthy of particular attention as they approach these smaller granitic masses.

3. In shear zones traversing the older rocks (Keewatin and Temiskamian) to contacts with the Algoman granite rather than in sheared zones which do not so terminate.

Geology Indicates Area of Great Volcanic Activity

The known Pre-Cambrian formations of the Red Lake-Birch Lake area may be summarized as follows, the oldest formations being placed at the bottom and the others in order of their relative ages.

	Pre-Cambrian
Keweenawan (?)	Quartz diabase
Post-Temiskamian intrusives (Algoman ?)	Granite, gneiss Granite, red and gray
	Igneous contact
	Granite porphyry Minette or mica lamprophyre Quartz and feldspar porphyry Diorite porphyry and related rocks
	Igneous contact
Temiskamian (?)	Conglomerate, greywacke Quartzite and slate Carbonate of iron
	Unconformity (?)
Post-Keewatin intrusives	Diabase and dolerite dikes
Keewatin?	Iron formation, rhyolite, dacite, andesite, basalt, altered diabase, Carbonate of iron

[8] Canadian Geological Survey "Report on the Country in the Vicinity of Red Lake." By D. B. Dowling.

[9] *The Northern Miner*, March 3, 1926, p. 7.

The two largest areas of lavas and sediments are along the Red Lake basin and east of Trout Lake lying between the Shabumeni and Wenasaga rivers. These areas are shown on the geological sketch map. This map is largely a compilation of information contained on Canadian Geological Survey map 9A (1910) and Dr. Dowling's map of the Red Lake basin, and additional information obtained by the exploration department of the Dome Mines, Ltd., has been added through the courtesy of H. P. DePencier, general manager. In both areas the sediments (Temiskamian) outcrop in the area between the granite mass and the Keewatin lavas. The sediments in the Red Lake basin have been carefully mapped by Bruce.[10]

Slate, conglomerate, greywacke, and quartzite outcrop along the Shabumeni River above Birch Lake. These have not been differentiated on any map, but appear to be an easterly extension of the sediments occurring at Red Lake. A detailed petrographic description of the various rock types to be found in the area is not necessary, since this phase has been fully covered in the government report.[11]

Summary of Geologic Sequence

The geological sequence of events may be summarized as follows:

A. A period of great volcanic activity during which time basic lavas of Keewatin age were extruded over a surface no remnant of which has been recognized. During this time minor sedimentation is also evidenced in the beds of fine-grained silica or jasper and magnetite together with some fine tuffs produced during the volcanic outburst or from lavas by local erosion.

B. Period "A" was followed by a prolonged erosion with some dynamic disturbances. During this period the rocks were mechanically broken up without much chemical alteration, and somewhat folded. The product of disintegration of these basement rocks was removed by rapid streams from neighboring areas and deposited in the Red Lake geosyncline to form the extensive beds of the Temiskamian series.

C. Period "B" was followed by a period of great dynamic disturbances during which the almost horizontal strata of the Temiskamian series were tilted into an almost vertical position and enfolded with the Keewatin lavas.

D. Probably coincident with "E" the quartz porphyry and granite porphyry were intruded into the older rocks, and this constituted the beginning of the epoch of Algoman intrusive action.

E. Overlapping or possibly coincident with the latter part of period "D" above, the large batholiths and bosses or masses of granite came into their chambers.

[10] Ontario Dept. of Mines, Map No. 33e, Red Lake Area.

[11] Ontario Dept. of Mines Report, Vol. XXI, pt. II, 1912, W. G. Miller; Vol. XXXIII, pt. IV, 1924, Bruce; Canadian Geological Survey, "Report on Country in Vicinity of Red Lake." By D. B. Dowling.

A few narrow dikes of trap and lamprophyre appear to have been intruded later than the porphyries and earlier than the massive granites. At the close of this period of intense igneous activity and dynamic disturbance came the beginning of the Algoman metallogenetic epoch during which the auriferous deposits were formed.

This brings the geological events to a close in so far as auriferous deposits are concerned. As noted in the geological succession, two periods of basic igneous intrusion have been identified. Since neither of these has any genetic relationship to the gold deposits, further mention has been omitted.

Structural Geology

Whether or not the "Golden Province" [12] is to produce another Porcupine or Kirkland Lake in this newly discovered area remains to be proved during the coming months by a thorough testing and examination of the only important find to date — the Howey — together with the diligent work of the prospector, which can, now that the snow has disappeared, be intelligently carried out.

As has already been pointed out, two factors seem absolutely essential for ore deposition: one, dynamic disturbance; the other, igneous activity. To date the economic gold deposits of Ontario all belong to that epoch following granite intrusions of Algoman age. Intrusive action will usually be most pronounced along zones of structural weakness. The presence of infolded Temiskamian sediments at once marks the area containing them as one having undergone great dynamic disturbances. A study of Map No. 33e by E. L. Bruce, of the Ontario Department of Mines, shows that these two vital factors are strongly evidenced in the Red Lake basin. In addition to the presence of Temiskamian sediments, the first factor is indicated by the shearing along the strike of the basin, and ample evidence of the second vital factor exists in the abundant intrusion of porphyries of Algoman age. What might be properly a third vital factor is "some gold"; this is evidenced along the "Howey find," which has been opened up by surface trenching alone for 1,000 ft., disclosing widths up to sixty-odd feet.

Red Lake Basin a Geosyncline

The Red Lake basin is structurally a geosyncline like unto that of Kirkland Lake and Porcupine. Much work remains to be done to determine the structure of the district, the interpretation of which is complicated by the metamorphic and engulfing action of the Algoman intrusives as well as the lenticular character of practically all the beds of Temiskamian sediments. The Temiskamian sediments occupy the synclinal troughs in the regional structure. Both the Keewatin and Temiskamian series have been closely folded and the strata thrown into approximately vertical attitudes or locally overturned. The minor anticline along the north of the basin has been destroyed by the intrusion of the granite.

Structurally, the Howey find is on the southern limb of the geosyncline in the Keewatin series, and it is thought that these rocks at one time flanked the sediments fringing Mackenzie Island on the north, forming a minor anticline. It is thought, also, that during the final stages of the intrusion of the Algoman granitic batholith, the wide pipe-like mass of granite occupying the south two-thirds of Mackenzie Island, and extending to the south shore of Red Lake, thrust and shoved aside the country rock and thus caused the formation of openings or easily replaceable zones by fracturing the country rock. The residual solutions carrying quartz, pyrite, galena, sphalerite, minor tellurides, and chalcopyrite, together with gold from the granitic magma, were concentrated along these zones.

Bruce[13] refers to the Mackenzie Island mass of granite as a batholith. This name hardly seems applicable to an intrusion of this form. Its form is truly odd and points to its being a huge cupola of the colossal batholith or a neck to a laccolith now obliterated by erosion. The northeast and south contacts have been observed in the field and have an almost vertical attitude. Hence there is no reason to fear the old calamity cry of "being cut off by the granite."

There are a number of linear valleys or depressions which are quite persistent along the strike. These according to strike fall into two principal classes: one extending north 63 deg. east, the other almost north. These linear valleys or depressions are the topographical expressions of faults and shear zones and hence are of economic importance in that they control the intrusion of the Algoman porphyries and the formation of the known gold-bearing discoveries. The north-south faults have not been exploited.

The Howey Discovery in Fault Zones

The Howey vein occupies one of the N. 63 deg. E. depressions. There are several parallel pronounced depressions of this type in which the hope is held that auriferous bodies may be discovered in the progress of work during the summer. These are not local. One has been traced from the outlet of Red Lake south of west through Lorne, Clara, and Bobs lakes, traversing the following properties: Red Lake Prospectors, Ltd., Howey, Victoria Syndicate, McIntyre, Cockeram, Nipissing, and Huronian Belt options, a distance of several miles.

The depression in which the "Howey find" was made can be traced for 1¼ miles on the Howey property, ¾ mile across the McIntyre, and beyond into the Red Lake Prospectors group. On the Howey the mineralized zone has been opened up for 1,000 ft., eastward from the McIntyre line roughly along the southern boundary of claim K.1365. The average strike is N. 65 deg. E., and the dip is steep to the south, varying from 82 deg. to vertical. The zone appears to consist of a wax-like sericitized quartz-porphyry mass of a series of small porphyry masses varying from a few feet to seventy-five feet in width "en echelon" to the left. Porphyry masses are in turn cut by numerous quartz veinlets from a fraction of an inch to two or three feet in width, the narrower veinlets predominating. In these masses the amount of quartz is between 5 and 10 per cent. The porphyry, which resembles that of Porcupine, intrudes the Keewatin. It is probably an andesite in composition and is rarely even mineralized or traversed by quartz stringers. Even when "horses" of Keewatin occur in the porphyry they are usually barren.

Mineralization in the quartz is roughly 2.5 per cent, and in the porphyry probably not more than 1 per cent.

[12] Ontario Department of Mines Report, Vol. XXX, pt. II. By P. E. Hopkins.

[13] Ontario Department of Mines Report, Vol. XXXIII, pt. IV, 1924, p. 34.

The predominant sulphide present is pyrite. There is a fair amount of galena and sphalerite; the former frequently occurs intimately admixed with pyrite. A little chalcopyrite has been observed. Tellurides of bismuth, lead, and gold have been identified, the most common being tetradymite, which occurs in bladed or foliated forms and is easily identified by its splendent metallic lustre, form, and pale steel-gray color.

Gold Occurs in Quartz and Sulphides

Free gold occurs as minute specks in the quartz and sulphides. It is commonly associated with the tellurides, galena, or sphalerite. Gold has also been observed in tourmaline and calcite. Coarse gold is rarely seen, and the gold, occurring as it does in an exceedingly fine state of subdivision, resembles more the gold of the central Manitoba gold area than any other local occurrence.

The pyrite in the porphyry is usually as minute cubes, whereas that in the quartz has been fractured and recemented by gangue minerals.

High-temperature minerals such as tourmaline, scheelite, and feldspar have been found. Tourmaline is quite plentiful in the quartz veins and as a marginal replacement to them. Other minerals found include iron-bearing carbonate (ankerite or siderite), a little calcite, and in places sericite.

The minerals mentioned, with the exception of the free gold, crystallized with the massive quartz, are indicative of contemporaneous deposition from the same solutions. In addition to filling the veins, there is a certain amount of replacement of the adjoining schist by the vein minerals, particularly the sulphides and tourmaline. Most of the quartz veins have been fractured, and some of the fracture planes slightly slickensided. Recrystallization of quartz and sulphides and the filling of the cracks in the quartz and sulphides with calcite, iron carbonate, and gold followed the fracturing. Most of the gold is in the recrystallized quartz or in the gangue material filling the cracks in the sulphides. Insufficient examination has been made to determine definitely whether gold was introduced as free gold after the fracturing or resulted from the liberation of intergrown gold in the sulphides. Very often the gold is in minute grains irregularly distributed throughout the quartz and shows no evidence of having been deposited along fracture planes; it therefore seems highly probable that all the gold was introduced contemporaneously with the quartz and sulphides before this later fracturing.

Values Not Yet Definitely Known

A statement of values obtained was made public early in the year by the Syndicate chairman, John E. Hammel, of Toronto. I am not at liberty to make public information concerning values obtained during the examination for Dome Mines, Ltd. For the sake of completeness the official statement as already published in the press made by H. P. DePencier, general manager, Dome Mines, Ltd., is repeated:

> "A large amount of sampling was done, and the results show values in many places. The incomplete nature of the trenching, though, does not permit of our joining up the ore sections in the various trenches, and much more work will have to be done to prove up the deposit. The fact, however, that gold is found over a length of at least 930 ft. and at places 60 ft. wide makes it necessary for us to further test the property."

Three diamond drills are now at work upon the property in further testing the deposit. Results of this work will be available at a later date.

McIntyre Claims Being Drilled

McIntyre-Porcupine Gold Mines, Ltd., has staked the nine claims contiguous on the west of the Howey. The main shear zone of the Howey traverses the property from east to west. Remnants of ore are found along the south flank of the depression that marks the shear zone. No surface trenching has been done, as the overburden along the main strike is too deep to open it up to advantage with pick and shovel. Two diamond drills are now at work on the property drilling the main zone at regular intervals. Geologically, this property differs from the Howey only in the closer proximity of the granite to the main strike.

Red Lake Prospectors, Ltd., owns a group of sixteen claims, thirteen of which are contiguous to the McIntyre group on the west and three to the Howey on the east. The property has not even been prospected. Three discoveries of free gold which are only of indicative interest were made during the staking last autumn. Geologically, the property is the same as the McIntyre to the east, except that it possesses, in addition, 1½ mile along the strike of the Clara Lake shear zone, which is one of the most pronounced in the vicinity of the Howey discovery. Thirty men began surface work on this group in May, to be followed by diamond drilling provided discoveries warrant it.

Area an Eastern Extension From Manitoba

The Red Lake gold area is an easterly extension of the Central Manitoba gold area, where both the W.A.D., operated by John Taylor & Sons Co., of London, England, and the Cryderman, owned and operated by the Mining Corporation of Canada, Ltd., are meeting with decidedly favorable results from the development to date. The area is one of extremely favorable geology and is only a stepping stone to another area lying to the east between Woman and Birch lakes, of equally favorable geology, in which some important discoveries are to be expected during the coming prospecting months.

Claim Owners Await Development by Larger Companies

The Howey discovery as opened up is the most promising gold discovery made in Ontario or Quebec during the last thirteen years, and this summer it is to be thoroughly tested.

Considering the attractiveness of the area geologically, its accessibility, and climate, power and other undeveloped resources, there is an astonishingly small number of prospectors in this general gold belt. Under the Ontario Mining Act one is allowed to hold a claim staked last fall in Red Lake until September, 1927, with only the performance of thirty days' assessment work, and when this takes the form of a land survey of the claims nothing is done to prove or disprove the mineral possibilities of the country. Under these conditions, and bolstered by exaggerated reports of the discoveries to date, large tracts are staked and held pending a possible development by legitimate mining interests in the area. For this reason it is quite possible that there may be attractive outcrops on claims now staked concerning which the owners know nothing, for only

approximately one-tenth of the 3,000-odd claims were not what is commonly termed "snow stakings."

Red Lake has been heralded as El Dorado found again, and the daily press has gratuitously superadvertised the area until one might almost expect the myth of the philosopher's stone fulfilled. Such a situation is far from the facts. Mining experience in Canada leads to the conclusion that development by booms has been the curse of the industry. Rice Lake, Central Manitoba, discovered and boomed in 1912, is in 1926 starting to respond to intelligent development; Gowganda, discovered and boomed in 1908, has apparently just come into its own; Rouyn, Quebec, boomed in 1921, is now proving up under development; Kirkland Lake, Ontario's second most important gold-producing area, was discovered and boomed in 1912, but only in the last four or five years has its importance been appreciated; and so one might continue listing camp after camp that has had to go through the vicissitudes of "booming." Is Red Lake due to suffer in the same way, for undoubtedly it has been boomed, with the sky the limit?

The area warrants prospecting, for in looking it over one cannot help be impressed by the geological setting and the number of places where gold values are obtainable. With such a wide distribution of gold there should be some deposits of commercial value, and it will require skilled, diligent, and painstaking prospecting to locate properties worth the expenditure required to make a producing gold mine in this newly discovered gold-bearing area.

In the Central Manitoba gold area,[14] presumably in the same geological province, the known quartz deposits are "in fractured and sheared zones cutting massive granite, granite porphyry, granodiorite, and the lavas near the contacts with these intrusives. Whether in the granitic intrusives or the lavas, the sheared zones are parallel to the contacts of these rocks, and where this contact bends there is a concentration of quartz deposits. The deposits of greatest known economic importance occur near or around the ends of wide, sill-shaped areas of granite porphyry, or coarse-grained dioritic phases of the granitic intrusives. Prospectors should give particular attention to such areas."

[14] Canadian Geological Survey, Summary Report, 1922, part C, p. 72c. By J. F. Wright.

Kalgoorlie Pyritic Gold Ore Amenable to Flotation

By Peter G. Tait
Melbourne, Australia

THE Western Australian Minister for Mines (Mr. Troy) has received a report on flotation tests made at the Kalgoorlie School of Mines on pyritic ore from the Celebration mine, Hampton Plains, by A. S. Winter and B. H. Moore. Treatment was delayed owing to pressure of work at the time of receiving the sample, which was comparatively fine, and it is thought these factors may have had a harmful effect on the amenability of the ore to the process. The report states that twenty-seven tests were carried out under conditions similar to those adopted for previously described tests in Kalgoorlie pyritic gold ore.

These tests fell into two series, according to the time occupied in flotation. The first series, consisting of the first ten tests, were given a flotation period of 3.5 minutes each; in the second series, consisting of the last seventeen tests, 10 minutes' flotation was adopted. The density of pulp was kept constant throughout, while variations were made in all other operating factors.

The results of the tests showed that: (1) This ore is amenable to flotation, and satisfactory recoveries can be made in the concentrates. (2) Though a mixture of kerosene and eucalyptus oil gave slightly better results than a mixture of kerosene, eucalyptus, and coal tar, the increased cost due to the larger proportion of eucalyptus oil used in the former case is a decided disadvantage and the small extra recovery does not compensate for the additional cost. (3) Results were not improved when pyridine was used in conjunction with the other oils, and for that reason and on account of the difficulty in procuring this reagent its use was discontinued. (4) The use of salt water may not be necessary with this class of ore, on account of the absence of colloids, but its use was adopted (5 per cent solutions) because conditions existing at the mine would entail the use of mine water for treatment. Salt in solution in the treatment water has been shown to be always beneficial. (5) The use of potassium xanthate as a conditioning agent in amounts varying from 0.09 to 0.74 lb. per ton resulted in no material benefit. (6) Extremely fine grinding of this particular sample was essential.

The ore was crushed dry to pass 16 mesh I.M.M. and then ground wet in the pebble mill for thirty-minute, forty-five-minute, and sixty-minute periods, the last named giving best results.

The results of these tests are calculated on the basis of the long ton of 2,240 lb. and make the grade of the residues apparently compare somewhat unfavorably with the grade of residues obtained on ores previously tested, in which cases, however, the short ton of 2,000 lb. constituted the basis for calculation. This also makes the proportion of oils used appear greater than in previous tests.

Copper Slags Useful for Cement

An article by G. Agde and P. Assmann in the *Zeitschrift für Anorganische Chemie* (1926, 39, 271-276), abstracted in *British Chemical Abstracts*, discusses the production of a hydraulic cement from copper slag. Slag remaining from the recovery of copper from its alloys with base metals, and containing 42 per cent SiO_2, 13.2 per cent FeO, 1.7 per cent Fe_2O_3, and 23.5 per cent CaO in addition to copper, aluminum, zinc, and magnesium, can be used for the production of a valuable cement by an ordinary oxidizing burning with the addition of lime; the most suitable proportion must be determined empirically. The presence of cupric and cuprous oxides is not detrimental. Phosphoric acid greatly diminishes the strength if more than 0.6 per cent P_2O_5 is present in the finished cement. If 3 per cent of gypsum is added, setting begins more slowly, but complete setting is accelerated.

Discussion

Genesis of Sulphide Ores

THE EDITOR:

Sir—Mr. Freeman's interesting attempt to transfer the applicability of his experimental work from its original electrochemical setting to a purely geological one deserves the attention of economic geologists generally. After having carefully read Mr. Freeman's article and his reply to its discussion, and given his useful suggestions the careful consideration they deserve, it seems to me that when the consequences of his theory are checked against observed geological facts evidence of the wide influence, which Mr. Freeman claims, of sodium sulphide as a solvent in ore deposition processes is not apparently forthcoming.

It is to be remembered that Mr. Freeman's suggestions are not altogether new, for Dr. G. F. Becker (Monograph 13, U. S. Geological Survey, 1888) wrote (p. 475) ". . . There is the strongest possible evidence for the supposition that the cinnabar, pyrite, and gold of the quicksilver mines of the Pacific slope reached their present positions in hot solutions of double sulphides." He also stated (p. 471), "Natural solutions of sodic carbonates and sulphides, which are common components of hot-spring waters, are thus capable of dissolving at least five of the principal metals, as well as sulphur, arsenic, and antimony." I have been unable to find authorities justifying Becker's assertion that sodium sulphide is a common component of hot-spring waters. W. F. Clarke, in "Data of Geochemistry," makes no reference to sodium sulphide; Lindgren ("Mineral Deposits," 1919, p. 63) refers to a group of springs in the Pyrenees in which sodium sulphide is constantly present and also refers to another case in France. Of course, in waters containing hydrogen sulphide it is possible that sodium sulphide is also present, but whether as an original constituent is an entirely different matter. The available evidence would seem to show that sodium sulphide is *not* a common component of underground waters.

According to Mr. Freeman's hypothesis, sulphides of metallic ore deposits were transported to the place of deposition in sodium-sulphide solution. Now, a necessary preliminary to this must have been the collection or concentration of the sulphides from the more deeply seated rock magma in which they were presumably dispersed at an earlier stage. To effect this collection, according to Mr. Freeman's theory, if I interpret it correctly, sodium sulphide must have permeated and searched the rock magma and "dissolved" the scattered sulphides existing there. Is it likely that this could have taken place without the necessarily thorough distribution of the sodium sulphide in the magma, leaving in the resulting rock, after solidification and crystallization, some recognizable evidence of the former ubiquitous presence of that compound? If the rock were acidic, it is to be expected from Mr. Freeman's recorded experiments that some at least of the free silica would have combined with sodium of the sodium sulphide to form alkali silicate. If the rock were basic, the sodium sulphide should have left some evidence of its former presence in the shape of sodic amphibole or pyroxene.

If we turn to actual ore deposits, and measure these consequences of Mr. Freeman's hypothesis against observed facts of mineralization, what do we find? Presuming, as seems justifiable, that effects of the former presence of sodium sulphide should be most noticeable in connection with the largest sulphide deposits, let us take the Rio Tinto (Spain), Mount Lyell (Tasmania), and Shasta County (California) orebodies. The first of these is the largest pyrite deposit known and the other two are of very large size. If Mr. Freeman's theory is correct and has general applicability, sodium sulphide should certainly have been operative in the formation of these deposits. What, then, are the observed facts?

At Rio Tinto, according to Finlayson, whose description is generally accepted as authoritative, porphyry, the igneous rock with which the ore deposits stand in closest relation, as a result of wall-rock alteration contains *less* sodium than the fresh rock does.

At Mount Lyell wall-rock alteration shows no evidence of the presence of solutions with high sodium content, according to Professor Gregory's description.

In Shasta County the country rock of the orebodies is sodic alaskite porphyry, and the alteration of this in the walls, as described by Graton, is sericitic, showing that the emplacement of the ore was attended by increase of potassium and *decrease* of sodium.

In the face of the observations, can it be seriously contended that a process of ore deposition involving the presence of large amounts of sodium sulphide is supported by the available evidence? This checking of Mr. Freeman's hypothesis and its consequences against geological observations, if applied to other sulphide deposits, would show the same results.

Albitization is, of course, common in connection with ore deposits, but can well enough be accounted for by ordinary hydrothermal action without resort to circulation of sodium sulphide. In spite of albitization, too, the overwhelming general tendency in connection with hydrothermal action on wall-rock attendant on ore deposition is *increase* in the amount of potassium and *decrease* in *sodium.*

Mr. J. E. Spurr, extrapolating from Mr. Freeman's experimental work, has assumed (*Engineering and Mining Journal-Press*, Dec. 19th, 1925, p. 977) that potassium sulphide would be present with the sodium sulphide. In any case, even if this assumption be correct, the amount of potassium salt present could only have been very small, for the solubility of potassium sulphide in a solution of sodium sulphide would be low, and, further, analyses of waters of mineral wells and springs (as, indeed, of all natural waters) shows that the element sodium is always present in overwhelming proportion compared to potassium.

Hence, if it be attempted to explain *increase* of potas-

sium during wall-rock alteration, attending mineralization, by the presence of potassium sulphide with the assumed sodium sulphide, in the case of the three ore deposits previously cited, the very awkward question has to be answered as to why the potassium sulphide, present only in small proportion, should have left evidence of its *supposed* presence, while sodium sulphide, present in much larger quantity, left none.

Mr. Freeman accounts for the absence of sodium sulphide in rocks by its oxidation to sulphate and removal in solution as such. Though this might apply to altered rocks in the zone of oxidation, it could not do so in the case of unaltered rocks or those lower down, and it is doubtful whether even in the zone of oxidation the sodium sulphide or its products could be so completely removed as to leave no recognizable evidence of its (or their) quondam presence.

There are numerous other points of Mr. Freeman's article in your issue of Dec. 19 last that call for criticism by geologists and mining engineers, but, until his views can be reconciled with observed fundamental geological facts, as indicated in the foregoing, it is useless to carry discussion further.

It may be stated here, however, that the mineralizing effects claimed by Mr. Freeman to result from the operation of solutions of sodium sulphide, the geological existence of which is *not* known, can be more easily and justifiably accounted for by the operation of sulphureted hydrogen (the geological existence of which is well established) as a solvent, peptizer, and protecting agent in the manner shown by the work of Tolman and Clark, Clark and Menaul, Young and Moore, and others.

I wish to add in conclusion that the validity of Mr. Freeman's chemical work is not in question here; that I merely criticise the application of his chemical results to the geological setting of sulphide ore deposits.

Cambridge, Mass. H. C. BOYDELL,
Department of Geology,
Massachusetts Institute of Technology.

Importations of Cryolite

THE EDITOR:

Sir—My attention has been called to an article in your issue of June 12, 1926, page 954; it is headed "Kentucky-Illinois Fluorspar Field." The end of the first paragraph reads: "Cryolite is a fluoride of aluminum, and occurs in nature only in one locality, at Ivigtut, in Greenland. Fluorite is a fluoride of lime, and since its use in making artificial cryolite became possible, importations of natural cryolite into this country have virtually stopped."

The importation of kryolith has been carried on by the Pennsylvania Salt Manufacturing Co., under an exclusive contract, since 1865. Shipments are made during the summer, and I understand there has never been a year since the date of the original contract in which ore has not been imported. Last year's shipments were the largest ever brought in, and the arrangements for this season will be, even at present, above the average.

You will kindly note that we use the name "Greenland kryolith." Cryolite is, I believe, an English form of the same word, but should not be used to describe the Greenland product. It is usually attached to the artificial or synthetic material. MIERS BUSCH,
Vice-president, Pennsylvania Salt Manufacturing Co.
Philadelphia, Pa.

Balancing Metallurgical Sheets in a Lead-Zinc Concentrator

THE EDITOR:

Sir—I notice, in the *Engineering and Mining Journal-Press* of Feb. 13, 1926, that in reply to an enquirer for a reliable formula for calculating extraction and recovery of both metals in a zinc-lead concentrator where two products are made, as calculations by quadratic equations had proved tedious and inaccurate, you publish the formulas given by T. R. Herndon in your issue of Dec. 12, 1925. As, however, your correspondent said that he had found difficulty resulting from plain mathematical treatment, that method would be open to the same objection.

If you refer back to your issue of Sept. 16, 1922, you will find a method that was evolved for dealing with cases of this kind which give rise to inconsistent equations. As is there pointed out, errors due to sampling and assaying which might at first appear negligible may entirely upset mathematical treatment, as your enquirer has apparently found. In such cases I believe the semigraphic method will give the nearest approximation to a true result. In addition, it will be found comparatively easy, as multiplication by a common factor lends itself to slide-rule treatment.

I suggest that you pass this note on to your correspondent and that on queries of this kind you attach a short bibliography in case the method you recommend does not entirely fit the case. ALFRED T. FRY.

Black Rock, Victoria, Australia.

Harry W. Dorman's Volatilization Process

THE EDITOR:

Sir—In the issue of your journal of May 8, on page 768, there was an article entitled "Volatilization Process Tried on Washington Ores." The article seems to have been sent to you by Roland King, mining engineer with the C. M. Fasset Co. of this city. It described in considerable detail the plan of construction of the furnace for this process.

In the article Mr. Koebel was given full credit by Mr. King for "the laying out of the plant." I ask that you give the parties who were responsible for the construction of the furnace such credit as it seems to me is due them. I do not believe Mr. Koebel would want to take credit for an accomplishment that should go to someone else.

I am secretary of a company recently organized, the Northwest Mining, Smelting & Refining Co., which will handle this process for the inventor, Harry W. Dorman. Mr. Dorman is responsible for the working out of the process, and the patents are now pending for such improvements on his furnace as he may be able to receive from the patent office. The furnace was planned and detail drawings were made under the direction of Mr. Dorman, who is president of this company, and the furnace was constructed on the property of the Consolidated Silver Mountain Mining Co., at the request of Mr. Koebel, with the agreement for royalty to be paid to Mr. Dorman, or his assigns, for its use.

The furnace was built by Mr. L. W. Pietsch, who has constructed furnaces for the American Smelting & Refining Co. for twenty-five years.

Spokane, Wash. J. W. WILLIAMS.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

BUREAU OF MINES moved to old Civil War Building—Magnesite subject of tariff hearings—Senator Cameron suggests a copper investigation.

Alaska School of Mines listing local occurrences of non-metallic minerals; oil shales discovered on Nizina River; Alaska-Juneau milled 317,000 tons during May.

Hollinger increases capacity and reduces costs—Developments at Red Lake promising—Kirkland Lake demands reduced power rate.

Treadwell-Yukon shipping 6,000 tons of concentrate and high-grade ore — New flotation plant at Rico, Colo.

Iron-ore shipments in 1925 exceed those of 1924 by 14 per cent—Aërial ambulance in Andes Mountains.

Arizona copper shipments en route to Eastern refineries via Panama Canal; Coronado trail opened; Stargo mines to be sold by sheriff.

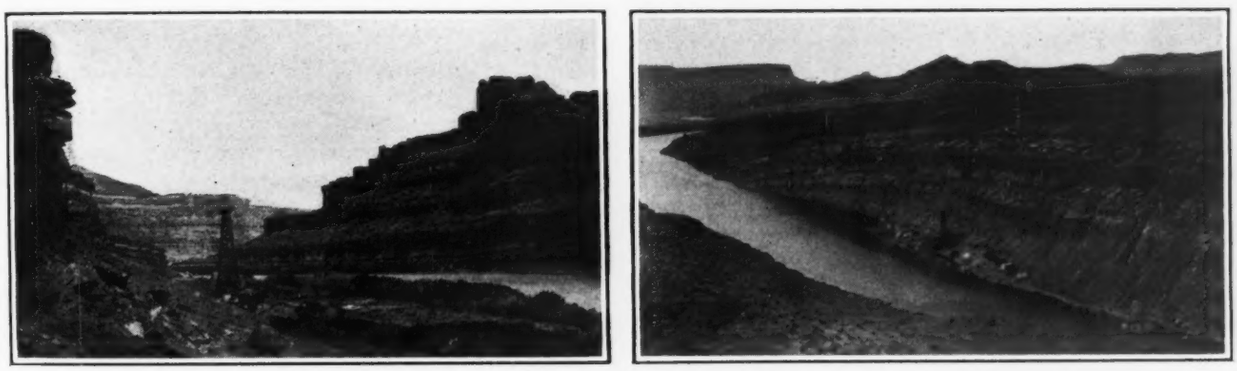
Calumet & Hecla construction program nears completion—New ore developing at Quincy mine.

International zinc syndicate in process of formation —Cornish tin mining gains.

Robinson Gold in process of liquidation—Transvaal platinum report issued.

Manitoba properties refinanced — Noranda options claims in Gowganda.

Presidio Mining Co. plans 300-ton mill for Shafter (Texas) mine.



Views of Frank H. Shafer Well No. 1, on Cane Creek Dome, south of Moab, Utah. Note domical structure at right

Mining Activity Increasing in Arizona—Much Prospecting Under Way

A quiet but steady revival of mining is pervading almost every section of Arizona. Large sums of money are being spent on development work in the revival of old mines by new methods and the opening up of new properties. This is not the work of the ordinary mining promoter, but that of men with capital. "No public stock for sale" is the rule rather than the exception with these new enterprises, and, consequently, they are not interested in publicity.

Undoubtedly, in the future, new copper mines will be discovered in the state, but at present no feverish hunt for them is going on. There was a time not long ago when the great copper mines of the state paid 60 per cent of the state taxes. Because of changed conditions in the industry, this proportion has been reduced to about 40 per cent, and the load has been shifted to other property. Copper mining, however, has come to be regarded as a stabilized industry and an important one.

The northwestern corner of Maricopa County, and the town of Wickenburg, which serves that district, have been monopolized almost entirely by capital from Nevada, and several well-known and reliable companies have secured property in that vicinity, where they are spending large sums of money in legitimate development. The United Verde Copper Co. is prosecuting development work at Mammoth, also diamond drilling in search of lead and zinc, south of Winkelman.

Large sums are being spent—more, perhaps, than were ever before distributed in Arizona within a similar period, and, best of all, this money is being spent in search for metal instead of promotion.

U.V.X. County Tax Adjusted

On June 21 an agreement was reached between the United Verde Extension and the Board of Supervisors of Yavapai County, Ariz., which will result in the payment of approximately $165,000 in disputed taxes and court costs.

Utah's First Gusher Now Under Control—Test to Be Continued From 2,000-Ft. Sand

Utah's first gusher, the Frank H. Shafer No. 1 well on Cane Creek dome, south of Moab, the Grand Canyon of the Colorado, has been started in the Hermosa member of the Lower Carboniferous. On Dec. 8, 1925, No. 1 blew in at 2,028 ft., caught fire, and burned the rig down. For weeks the crew fought to conquer the recalcitrant well. Ten-inch casing collapsed and the fact that the water stratum overlying the oil horizon is parted by only four feet of formation has made it impossible after weeks of trial to get the water shut off in order to test the sand at 2,028 ft. It has now been cased off and drilling to lower objectives started. However, numerous times the well broke loose, threw the water column out of the hole, and made oil at the rate of fifty barrels an hour.

Many other wells are now being drilled and the field promises to be a good producer.

Spanish Mine Under Development —Barite Deposit Opened Up

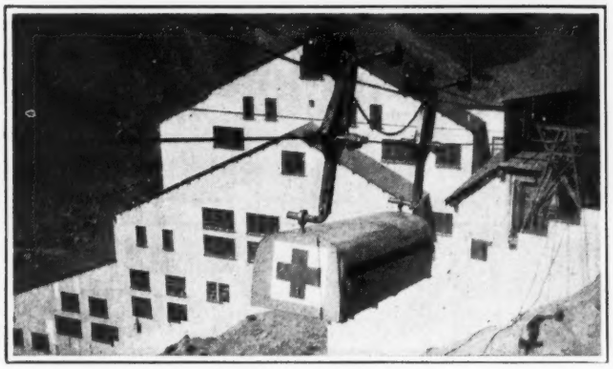
The Spanish mine, in Nevada County, Calif., near Washington, is being developed by F. W. Bradley, of San Francisco. This property was operated a number of years ago. It is now being explored, and if sufficient tonnage is developed a small mill will be built. Mr. Bradley is also extending the development of a barite deposit between North Bloomfield and Graniteville. About 200,000 tons have been blocked out, and plans contemplate sufficient additional development to double this tonnage, at which time equipment will be installed and a wire-rope tramway to the railroad at Emigrant Gap will be constructed. Other interests, principally the Glidden Paint Co., have acquired barite deposits in California and are preparing to manufacture lithopone in a plant near Oakland.

Aërial Ambulance in the Andes

The Caracoles tramway, in Boliva, was erected two years ago. The total length of this system from the Caracoles tin mines across the main range of the Andes is eight miles. Maximum elevation attained is 16,414 ft., and the longest span is 2,200 ft. The capacity is 15 tons per hour. An ambulance was recently placed on the main tram section. This section is 5½ miles long and extends from the sorting plant at the Argentine mine (15,600 ft.) over the pass at 16,414 ft to the mill at 12,000 ft. elevation. By means of this ambulance, employees who have been injured or become ill (mainly from pneumonia, owing to the great elevation) are brought from the mine to the mill and thence by other conveyance to the hospital, which is 1,000 ft. lower than the mill. The time required is an hour and a half, whereas carrying stretcher cases over the trail and motor road, the ordinary means of travel, would require from five to twelve hours. This unusual ambulance is daily proving a lifesaver at the famous tin mines. As many as five cases have been carried in a single day. The ambulance was designed and constructed in the shops of the Caracoles Tin Co.

Thirty-one Mile Aërial Tramway in Peru Near Completion

Twenty-five and one-half miles of aërial tramway line have been completed by T. H. Graham & Sons in the Department of La Libertad, Peru, for account of the Northern Peru Mining & Smelting Co. When completed the system will be 31½ miles long, extending from Samne to Shorey and Quiruvilca, smelter and mine site, terminating at Callacuyan, in the neighborhood of the coal mines and limestone beds. The longest span on the system is 4,251 ft. at Shorey, 1¼ in. cable being employed. The transport capacity of the cableway is 60 tons per hour. During the construction period at Shorey, from 25 to 35 loads a day of 1,400 lb. net have been conveyed to that point, some of the loads consisting of lumber 30 ft. long.



Aërial tramway ambulance, Caracoles Tin Co., La Paz, Bolivia. Mill at right

Tonopah Belmont Developing Ore in Arizona

The Tonopah Belmont Development Co., Tonopah, Nev., is prosecuting development work at the two properties recently acquired in Arizona. At the Belmont mine, in Superior, Chester Hoatson, superintendent, the company is reported to have an oreshoot fully 800 ft. long and heavily mineralized with silver, lead, copper, and zinc. So far, four veins are reported to have been opened up at the mine.

At the old Washington mine, in Maricopa County, about 28 miles southwest of Wickenburg, the company is meeting with equal success. This property, on the McNeill estate, about 14 miles south of the Vulture mine, and approximately 73 miles northwesterly from Phoenix, has remained dormant for many years. Very little was done to revive activity until 1925, when C. K. Barnes, formerly general manager of the Yellow Pine Mining Co., Good Springs, Nev., and his son, R. H. Barnes, began work in the long-abandoned shaft. Their preliminary examination led them to obtain a lease bond and option on the property. After spending several thousand dollars of their own money, they succeeded in interesting the Tonopah Belmont Development Co., to take an option on the Barnes option. Last February, the company paid off the option, and it has spent about $275,000. The Washington mine community is now known as Camp Belmont.

Arizona Copper Shipments via Panama Canal

The first shipment of 300 tons of Arizona copper left Los Angeles for Chrome, N. J., in May, and was about three weeks in transit. Since that time the Harbor Department of Los Angeles reports that Arizona copper is moving out at the rate of about 200 tons every five days. The rail rate to the East from Arizona smelter points to Chrome is $12.50 per ton. At present the rate via Los Angeles and the Panama Canal is $11.50. Of this, $6 per ton is for the rail haul from Arizona points to San Pedro harbor.

Present shipments originate from only one producing smelter, but demonstrate that it is a feasible route, and representatives of the Harbor Department are visiting the other smelters in Arizona in an effort to increase these shipments. San Francisco has been able to secure a more favorable rate on copper for about the same length of rail haul from Utah, with the results that 150,000 tons of copper moves through that port yearly.

Wrigley Ships Zinc Concentrate to Belgium

The Wrigley mines, on Catalina Island, continue to develop satisfactorily. The shaft on the Black Jack lead-silver mine has reached a depth of 400 ft. and is stoping ore from a 4-ft. vein on the 200 level. Four shipments of concentrates have been made recently to the Selby smelter. A shipment of 400 tons of zinc concentrate was loaded on the S.S. "Iowa," June 19, for shipment to smelters at Menin, Belgium. This is the fourth such shipment in recent weeks. The Black Jack property has completed the installation of a complete electrical equipment and an aërial cableway two and a half miles long. This equipment will do away with a large fleet of trucks that have been making an eight-mile haul over a circuitous mountain road to the wharf.

Alaska Juneau Milled 317,000 Tons in May

Alaska Juneau Gold Mining Co. reports 317,000 tons mined and trammed to the mill in May, 1926. Receipts were $161,500 and operating expenses $150,200, leaving a net operating profit of $11,300 for the month. Other expenditures and accrued charges totaled $28,300, leaving a deficit of $17,000 for the month. Addition to the milling plant is reported 79 per cent completed and Ebner preliminary work 82 per cent completed.

Alaska College Assists in Developing Natural Resources

Ernest N. Patty, dean of the Alaska Agricultural College and School of Mines, Fairbanks, Alaska, has organized a class to study and publish information concerning the resources of the Territory in non-metallic minerals. The study has been undertaken to supply the pulp industry with its requirements of such minerals and to assist in the development of traffic for the government railways. Stimulus has been given to the study by the activities of B. L. Thane, who is now at Juneau with pulp and paper experts, organizing an industry to use the water-power development of the old Alaska-Gastineau mine. In a paper compiled by George E. King, a student of the School of Mines under Dean Patty, is given a list of occurrences of pyrite, gypsum, barite, magnesite, limestone, dolomite, talc, and sulphur.

The marble quarries of the Vermont Marble Co., at Tokeen and Calder, are actively engaged in producing marble for the new State building at Olympia, Wash., the industry employing about 125 men.

Recent Alaskan Developments

The Alaska Hills Mines Corporation has begun milling operations at Nuka Bay, where there are promising gold-quartz deposits.

Litigation between the Willow Creek Mines, Inc., Wasilla, Alaska, and the owners of the Lucky Shot claim has been settled by the Willow Creek company buying the latter property.

The Goldsmith Dredging Co., of Spokane, associated with the Silversmith mining interests, has acquired twenty-one claims on Solomon River, near Nome, and is installing a dredge, operated by Diesel engine power. The company estimates that it has 4,000,000 cu.yd. of gravel which will average 60c. per cubic yard.

Oil-shale deposits are reported to have been discovered on the Nizina River, and have been traced to Dan and Young creeks. Samples of oil produced from this shale have been brought to Kennecott. The General Petroleum Co. of California has sent a drilling crew to Icy Bay to test out the Yakataga field.

Treadwell-Yukon to Ship 6,000 Tons

It is expected that the Treadwell-Yukon Co. will ship from its Mayo properties 6,000 tons of crude ore and concentrates during the present season. About one-half will be concentrates from the mill at the Wernecke mine and one-half crude ore. During 1925, it is estimated that the Wernecke mine netted an estimated operating profit of $570,397 after paying for 3,716 ft. of underground development and mining and hoisting 28,041 tons of ore averaging 42 oz. silver, 4.4 per cent lead, and 5.6 per cent zinc. Allowance is made for estimated smelter returns on ore and concentrate produced and sacked for shipment from Keno Hill, Yukon, during the year but not shipped.

There was milled during 1925, 40,435 tons, which yielded 2,533 tons of concentrate, of which 1,292 tons was shipped and 1,241 tons awaits shipment. Total concentrate averaged 609 oz. of silver per ton, 52.4 per cent lead, and 6.6 per cent zinc; crude ore amounted to 302 tons, of which 165 tons was shipped and 137 tons awaits shipment. The average of crude ore produced was 242 oz. of silver per ton; 56.4 per cent lead, and 6.5 per cent zinc. Ore reserves proved and partly proved at end of 1925 amounted to 83,500 tons, and 250,000 tons of probable ore reserve.

The last payment on the Wernecke mine property will be made in August, 1926. Options on additional mining property are being secured in the Mayo district. Treadwell-Yukon is also interested at Tybo, Nev., where the Tybo mine has been reopened, and in the Sudbury district of Canada, where the Errington property is being explored.

Prospectors Find Free Gold in Woman Lake Area

Attention of prospectors in the Red Lake mining division of northern Ontario is now largely directed to the area around Woman Lake, where several discoveries of free gold have been reported. The center of interest is at the narrows at the south end of Woman Lake, where the original discovery was made by a prospector named Powell, who has staked out a number of claims. This was followed by a later discovery on the Rowe properties, where the vein is said to have been traced for three miles with showings of free gold. Free gold has also been found on the Jackson properties adjoining the Rowe. The formation comprises greenstone and porphyry intrusions similar to those of the Red Lake area. The country is favorable to prospecting, being practically free from heavy timber, and with a light overburden.

Northland Mine Opens Molybdenite Vein

The Northland mine, Kirkland Lake, Ontario, has encountered a vein, 12 ft. in width, containing molybdenite, on the 500 level. Assays across the vein show values as high as $6. Drifting has been started along the footwall, and the first rounds taken out are said to show some improvement. The property is being operated by power from the Argonaut mine.

Presidio Company Plans 300-Ton Mill for Shafter Mine

Not only are the mining operations of the Presidio Mining Co., Shafter, Tex., to be greatly enlarged, but the company has adopted plans for a 300-ton cyanide mill for the treatment of its silver ore. It is stated that this mill will be constructed immediately. The Shafter silver mine has been worked constantly for more than forty years. During that period it has had an average annual production of $500,000 of silver. The company owns a large area of mineralized lands situated adjacent to the mine, and its development plans call for the possible opening of new mines upon the property.

Michigan College of Mines Has Elaborate Triangulation System

Under the direction of the civil and mining engineering department of the Michigan College of Mines, sixteen large steel triangulation tripods have been erected on various points in the college triangulation system, which covers an area of approximately ten square miles. The system is part of the scheme used for the convenient and efficient instruction of students in surveying and other civil-engineering projects. It is said to be the largest and best-equipped triangulation system in use by any college in the country.

Consolidated Declares Dividend and $3 Bonus

The Consolidated Mining & Smelting Co. of Canada has declared a dividend of 75c. and a bonus dividend of $3 per share on its 507,012 outstanding shares of capital stock, covering operations for the first half of this year. This disbursement will amount to $1,901,295, and will bring the company's total disbursement up to $13,237,155.

The company has started work on an addition to the lead department at Trail. For the time being, the excess of zinc concentrate that cannot be handled at Trail will be shipped to foreign smelters. The new 20,000 hp. unit of the West Kootenay Power & Light Co., a subsidiary company that provides the Trail smelter with electric current, should be in operation by the end of August. With ample current assured, the Consolidated company may increase the capacity of its zinc department, which is 200 tons per day.

Bonanza Ore Found in Portland Canal Area

A strike of bonanza gold ore is reported to have been made by B. C. Silver Mines, Vancouver, B. C., on its property to the northwest of the Premier mine, in the Portland Canal mining division, and the discovery of a four-foot vein, assaying several ounces of gold per ton, is reported to have been made at the Big Missouri mine.

Hollinger Consolidated Increasing Capacity and Lowering Costs

Hollinger Consolidated is treating approximately 1,000,000 tons of ore in six months. Underground developments and preparations on the surface have been progressing so favorably that by the end of the current year the annual output will attain a rate of 2,800,000 tons. The first stage of the program for deeper mining includes extension of the workings to the 3,000 level. Shafts, hoists, and equipment have all been designed with this object in view. The area below the 3,000-ft. horizon is to be dealt with in due time by excavating a large station at the 3,000 level, where additional hoists will be installed and shops established. Operating costs of taking ore from the lower levels have recently attained a lower rate than that on the upper levels. It is officially stated that total costs can be reduced to $3.25 per ton.

News From Washington

By PAUL WOOTON
Special Correspondent

Bureau of Mines Now Quartered in Civil War Hospital and Warehouse Annex

THE U. S. Bureau of Mines has moved from its up-to-date quarters in the Interior Building and now is housed in a remodeled Civil War hospital and warehouse. The new home of the Bureau is known as the Winder Building. It is situated at Seventeenth and F Streets, one block east of the present location. As the building will not house the entire Bureau an old store building next door is being rehabilitated to take care of the overflow.

The building was erected in 1848 as a hotel, but was rented by the government until 1854, when it was purchased for the use of the War Department. The record fails to show when the "seagoing elevator" was installed, but this encroachment of a device of a more modern age does not detract from the ancient appearance of the edifice except the violence done when the shaft was sunk.

Coal bins formerly in the basement have been removed, and the mimeographing section has been set up in surroundings which will portray Libby prison to visiting mining men.

That lack of consideration of the mining industry which has been shown by the Public Buildings Commission in the assignment of this space, it is pointed out, does not depart far from the attitude of Congress itself.

Tariff Commission Considering Magnesite

Briefs will be submitted to the Tariff Commission July 19 by parties at interest in its investigation of the costs of producing crude magnesite and caustic calcined magnesite, a public hearing in which was held on June 21 and 22.

Owing to the fact that there are so few domestic producers, and the further fact that most of the foreign costs were secured in confidence, the hearing failed to bring into public view any comprehensive figure which would indicate the real differences in cost. Most of the testimony and argument therefore was devoted to figures on importations, rail and water freight rates, and comparability of the domestic and foreign product for use in stucco construction work.

Several consuming companies presented witnesses who testified that they used either the domestic or foreign product with equally good results, despite some differences in color. One testified that he purchased about 25 per cent of his supply from importers at $2 per ton above what he paid for the domestic magnesite, merely to have assurance of two sources of supply.

The case before the Commission is the result of applications for a higher duty filed by the Sierra Magnesite Co., Porterville, Calif., and C. S. Maltby, San Francisco. H. A. Golwynne and Innes, Speithen & Co., both of New York, the principal importers of magnesite, opposed an increased duty, being represented by W. G. Merritt, of New York, as counsel. An application filed in 1923 by four Austrian producers asking a decrease also is pending.

Mexican Mining Law Not Confiscatory

Translations of the new Mexican mining law show that the policy of eliminating the foreigner is being continued. The extent to which this law is less favorable to the foreigner than the one it repeals cannot be told until administrative regulations have been issued, but it is evident that it will deter new capital from undertaking Mexican operations. The immediate effect of the law, however, is expected to stimulate output. Work under the conditions imposed doubtless will be concentrated on getting out ore. Development work probably will be sacrificed.

While any direct attempt to confiscate or apply retroactive conditions is avoided, it is plain that the purpose of the law is gradually to force the mineral properties of the country into Mexican ownership. Present titles issued in perpetuity are to be exchanged for "concessions" limited to fifty years. If not exchanged within twelve months all rights are forfeited. The new law by requiring a minimum production practically eliminates the small operator and the prospector. At the same time the large operator is hard hit by the provision that no mining property may consist of more than 100 pertenencias.

Editor's Note:

The above Washington letter reflects certain views of official Washington. Due to the fact that policy as a rule prevents government officials from permitting their views being quoted directly, the authority for these reports is necessarily somewhat vaguely referred to. The views reflected from time to time are not those of any one group of officials, but of different men, in the legislative and executive departments. There is no necessary connection between their views and "Engineering and Mining Journal" editorial policy; neither do they necessarily represent Mr. Wooton's personal views. It is felt that the opinions thus faithfully reflected will be of great interest to the industry.

Where opinions are cited from sources outside of the government, the source will be specifically stated.

Iron-Ore Shipments in 1925 Exceed 1924 by Fourteen Per Cent

Iron ore mined in the United States during 1925 totaled 61,907,997 gross tons, an increase of 14 per cent over the figures for 1924, according to U. S. Department of Commerce. Shipments in 1925 were 63,924,763 tons, valued at $161,796,886, an increase of 23 per cent in quantity and 6 per cent in value over the 1924 record. The average value per ton of iron ore at the mines in 1925 was $2.52, or 39c. less than a year before. Stocks of iron ore at the mines at the end of last year were 10,795,630 tons, against 12,410,619 tons at the end of the preceding year, a decrease of 13 per cent.

Cameron Wants Copper Industry Investigated

Extreme indifference was the response of the copper market to the resolution of Senator Cameron, of Arizona, introduced in the Senate on June 24, calling for an investigation of the business this summer. In some quarters the action was looked upon as a helpful development in connection with the plans of the industry to organize a copper export association. The inquiry called for is calculated to show, according to responsible copper executives, that such an organization is greatly needed, not only as a stabilizing agency but as a means of broadening the market for the products of American copper producers. The general belief appeared to be that the inquiry proposal was made as a result of the plans for the organization of the copper export group.

Coronado Trail Opened

The State of Arizona has constructed a modern highway from Clifton into the White Mountains on the Arizona and New Mexico boundary. It is 386 years since Don Francisco Vasquez de Coronado passed this way. On June 22, approximately 6,500 people, representing every state in the Union but three, assembled at the Forest Ranger's Station, known as "Hannigan's Meadows," in the Apache National Forest, to dedicate the Coronado Trail.

One of the most important features of the dedication ceremony was a talk given by "Al-chay-say," for forty years ranking chief of the White Mountain Apaches, who during the years of 1860-1861, and some ten years thereafter, proved such a scourge to Arizona, but who have been at peace with the white settlers for nearly forty years.

With the opening of the Coronado Trail, the completion of the Springerville Road, and improvements on the Globe-Rice-Springerville road, it is quite likely that this territory may receive considerable attention from mining men in search of new deposits.

Stargo Mines to Be Sold at Sheriff's Sale

The property of the Stargo Mines, Inc., Morenci, Ariz., is to be sold at sheriff's sale, July 7, according to a notice of sale that has been published. A judgment against the company of $29,331.21 was recently given Morris Kullman in the Superior Court of Maricopa County, Ariz.

According to the notice the property to be sold consists of twenty-five mining claims in the Morenci district, four of which are patented.

Southern Pacific Collecting Data on Mineral Deposits

The Southern Pacific R.R. Co. is compiling information relating to the location of non-metallic mineral deposits in California, Oregon, Arizona, and Nevada. It is the desire of the railroad to circulate full information concerning such deposits to users of the mineral involved, and to place in the hands of the nation's manufacturers data relative to all mineral resources.

Idaho-Maryland Sues Brunswick Consolidated

The Idaho-Maryland Mines Co., Grass Valley, Calif., has filed suit in the United States District Court to recover $100,000 which it claims was taken from its gold-ore properties in Nevada County, Calif., by the Brunswick Consolidated Gold Mining Co.

Plaintiff also asked for an injunction to stop the alleged apexing by the Brunswick company.

Appellant also asks that the intended sale of the Brunswick company on June 30 be held up until the issue is decided.

Calumet & Hecla Construction Program Nears Completion

The present year will see the virtual completion of Calumet & Hecla Consolidated's big construction program. Installation of a large casting machine to serve the new refining furnace at the Hubbell, Mich., smelter will complete the major projects. Delivery of the machine is expected in September. Ahmeek of Calumet & Hecla is shipping about 3,200 tons of copper rock daily, refined production per month probably running 2,700,000 lb.

The Mohawk Mining Co., Mohawk, Mich., is stamping to the capacity of its mill. This property will equal, or better, its 1925 record. Mill losses have been reduced to a minimum through the installation of regrinding units.

Seneca Copper, near Mohawk, Mich., has resumed sinking in No. 1 shaft, which will be lowered 300 ft. before the next level is established. It is now bottomed at the 7th. The new level will be at a depth of 4,182 ft. below the Kearsarge lode outcropping on this property. The No. 2 shaft will be stripped from the 18th to the 19th level. No. 3 shaft will soon be ready for use.

A representative of the U. S. Bureau of Mines, which is filming "The Story of Copper," is expected in the Michigan district this month to take underground and surface pictures, embracing mining, milling, and smelting practices. The completed "story" will be comprehensive, representing operations in all of the copper districts of the country.

Quincy Prospects Improve

At the Quincy mine, at Hancock, Mich., the rich east lode of the Pewabic series, which was found heavy with copper at the 85th and 86th levels of No. 2 shaft and the 83d level of No. 6, has been opened at the 87th, the bottom level of No. 2. The copper content is far above the average of the mine, and the width is encouraging.

Duthie Strikes Bonanza Ore

A strike of bonanza silver ore has been made in the Henderson mine, 13 miles from Smithers, B. C., owned by Duthie Mines, Ltd., Wallace, Idaho. The strike was made in a crosscut from a winze at a point 50 ft. below the tunnel. It consists of ten to fourteen inches of solid galena, through which run bands of native and ruby silver.

It is just a year ago since J. F. Duthie regained control of the property, which for more than a year was under option to the Federal Mining & Smelting Co. Since regaining control Mr. Duthie has shipped 43 cars of ore to the Trail smelter, and would have shipped another 20 cars but for the wretched state of the road between the mine and Smithers during a large part of the winter. All available space is loaded with ore ready to ship. The average of the ore shipped nets the company around $90 per ton at the railway.

Old Powder Said to Be Cause of Accident

R. B. HILL and M. J. DONOGHUE, operators of the Blue Ribbon mine near Paradise, Ariz., were found to be responsible for the accident to John Gurchan, an employee, who lost the sight of one eye and had the other eye severely injured as a result of being blasted while working at the mine. According to the report of deputy state mine inspector, James Malley, the powder which was in use at the mine was nearly four years old and was extremely dangerous to use. Malley destroyed the remainder of the powder after investigating the accident. The mine had been operating only two weeks when the accident occurred. Gurchan, who was sixty-five years old, was in the act of blasting five holes when one of them exploded prematurely, blowing dirt and rock into his face.

New Flotation Plant at Rico, Colo.

Construction of a 250-ton selective-flotation plant by the International Smelting Co. is well under way at Rico, Colo. Part of the new mill will occupy the old Pro Patria building. Ore bins and extensive additions are being erected. Operations are in charge of W. C. Page. The company expects to have the plant ready by Sept. 1.

Housing in Rico is so limited that the company has had to erect tent houses for shelter until more permanent quarters can be built.

Production of the Rico Argentine mine, at Rico, Colo., is averaging about a carload a day. In view of the increased prices for lead and zinc, the output is to be augmented. Operations in the Rico district are hampered by a shortage of labor. Work is being centered on two levels—the lower or Argentine level and the Log Cabin level, about 300 ft. above. Recently in the No. 1 replacement vein on the Argentine level a bed of ore 12 ft. thick was exposed. Work of crosscutting this bed is under way.

Quicksilver Furnace to Be Installed in Oregon

The Opalite quicksilver mine, now being developed by the Mercury Mining Syndicate under the management of Clifford Dennis, for F. W. Bradley, of San Francisco, is to be equipped with a rotary furnace of 100 tons' capacity per day. Furnace and accessory equipment has been shipped to the mine, which is north of Winnemucca, Nev., a short distance from the Nevada-Oregon line in Oregon. A considerable tonnage of quicksilver ore has been opened. It is expected that production will be fifteen flasks per day.

Electric Point Secures Big Tax Reduction

F. M. Turner, an attorney, of Northport, Wash., secretary of the Electric Point Mining Co., reports that the Treasury Department at Washington has accepted $15,000 which the company tendered in settlement of back income taxes which the government claimed amounted to $120,000. The matter has been under adjudication for several years.

New Orebodies in Stevens County, Wash.

Two important strikes are reported in Stevens County, Wash., one of which is in the Old Dominion, 7 miles west of Colville, where a lead-silver orebody ten to eleven feet wide has been opened. The ore was struck at a depth of 700 ft. below the surface where what is supposed to be the same orebody carried manganese. The management believes the ore will extend to the surface. Oscar Hershey, mining engineer, of San Francisco, recently made an examination of the property, but has not submitted his report. The property is under the management of W. H. Linney, mining engineer, of Spokane.

Conrad Wolfe, of Spokane, reports three feet of high-grade copper-silver ore in the Amazon, one of the groups brought together by the United Mines company, which has the United Silver-Copper and Copper King. The three feet of shipping ore is in an eight-foot orebody. The strike was made at a vertical depth of 225 ft. and is in the same vein which forty years ago produced nineteen carloads from a 140-ft. shaft. Three miles west of Colville the Lucky Stone has struck five to six feet of clean ore.

Carbon Black Plant for Cisco, Utah

Construction of the first unit of a carbon-black plant by the Crystal Carbon Co. has been begun at Cisco, Utah, near the Colorado line. The first unit of the factory, embracing thirty buildings, employing from twenty-five to forty men, will have a capacity of 4,000 lb. of carbon black daily, according to Fred Engstrom, field superintendent. The gas flow developed by the Utah Oil Refining Co. on the Cisco dome will be utilized. One of the principal obstacles to carbon manufacture has been the shortage of water.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Optimistic Feeling as Result of Dome Development at Red Lake

It is reported that at the Dome mines, South Porcupine, 30 ft. of high-grade ore has been encountered in a diamond-drill hole 200 ft. below the 16th level. No official confirmation has yet been given, but the information comes from reliable sources. There is also a quiet feeling of optimism regarding the company's property in Red Lake. Diamond drilling is understood to have given results which compared favorably with the surface assays. One drill has now been moved to a point 1,200 ft. west of the last surface trench, and if the vein is picked up here a number of other holes will be put down and the drill then moved another 1,000 ft. to the west. When the company took the option on this property it anticipated carrying on a program of exploration until next October, by which time it was felt that a decision could be made, and it is doubtful if any official announcement will be given out sooner.

Aside from the operations by the Dome and the McIntyre, comparatively little work has been done in Red Lake to date. Most of the claim holders seem to be waiting for these two companies to prove up the field for them, but it is felt that if some real work were done other discoveries might be made, as with a comparatively small amount of work the Dunlop Red Lake Syndicate uncovered promising ore.

The Tough-Oakes property in Kirkland Lake will soon enlarge its mill. Better results are being encountered in the ground lying to the east of the big diabase dike. Former work had been concentrated to a large extent between this dike and the Sylvanite boundary, but with the new ore which has been found to the east, the position of the company has been much improved.

As predicted some time ago the Hollinger, of Timmins, has increased its dividend from 1.6 per cent to 2 per cent every four weeks. The first dividend at the increased rate will be payable July 15.

Big Missouri Plans 200-Ton Mill

Duncan MacVichie, consulting engineer, of Salt Lake City, has been retained to design and construct the metallurgical plant for the Big Missouri Mining Co., Tacoma, Wash. This company has been prosecuting a vigorous development compaign at its mines on Salmon River, Portland Canal, with successful results. The estimated reserve in one block is 750,000 tons. Three other veins are under development. Values are in gold, silver, lead, copper, and zinc. A 200-ton mill will be constructed this year. A small lead stack for smelting the lead concentrates is proposed. Copper concentrates will be sent to the Granby company's smelter at Anyox and the zinc concentrates to Selby or shipped to Belgium.

Cedar Creek Hydraulicking Successfully

The Murray-McGregor Co. and the Cedar Creek Gold Mining Co., Vancouver, B. C., which jointly are interested in a consolidation of claims at Cedar Creek, near Quesnel, in the Cariboo division, have made a clean-up of 669 oz. of gold, as the result of one week's hydraulicking. The companies have had difficulty in starting work, owing to the location of the claims, which are high-bench claims, some 600 ft. above the creek. The difficulty has been overcome by flooding some old workings and pumping the water from them to the top of Cedar Hill. After the water has been used it is returned to the old workings by way of a series of brushwood screens and settling pits, ready to be used over again.

Canadian Production of Asbestos in 1925 Exceeds All Records

A new high record was established in the Canadian production of asbestos in 1925. Total shipments for the year were 290,389 short tons, valued at $8,988,360, compared with 225,744 tons valued at $6,710,830 in 1924, according to finally revised statistics on the industry just issued by the mining branch of the Dominion Bureau of Statistics at Ottawa.

Principal Statistics of the Asbestos Mining Industry in Canada, 1924-1925

	1924	1925
Number of firms	15	14
Capital employed	$43,216,966	$38,133,046
Number of employees:		
On salary	125	117
On wages	2,472	2,465
Totals	2,597	2,582
Salaries and wages:		
Salaries	$288,459	$280,085
Wages	2,688,845	2,717,022
Cost of fuel and electricity	760,046	923,239
Selling value of products	6,710,830	8,988,360

Kirkland Lake Operators Unite for Reduction of Power Rate

Much dissatisfaction prevails among the operators of the Kirkland Lake gold-mining area of Ontario over what they consider the extortionate rates charged for the supply of power. Rates under the existing contracts are based upon the limited requirements of the earlier days of the camp. They are paying on the average about twice the rate charged the mines of the Porcupine district. The operators have arrived at a mutual understanding for a united effort to secure what they consider a reasonable adjustment. In case a satisfactory rate cannot be otherwise secured, there is a strong sentiment in favor of an appeal to the Ontario Government to order an investigation.

Installation of Ankerite Mill Completed

The new Ankerite mill, in the Porcupine gold-mining area of northern Ontario, which has a capacity of 300 tons daily, has gone into operation, and is treating about 150 tons per day. It is of the most modern design of all-steel construction, being the first of this kind in northern Ontario.

Johannesburg Letter

By John Watson

Special Correspondent

Robinson Gold, Famous Witwatersrand Mine, in Process of Liquidation

Johannesburg, May 25—The thirty-sixth annual meeting of the Robinson Gold Mining Co., Ltd., was held at the Corner House, Johannesburg, on May 17, Frank Raleigh presiding. After the ordinary business, an extraordinary meeting was held to consider the liquidating of the company. The chairman gave an interesting survey of the records of the Robinson company, which was formed in 1887. In its day it was one of the richest gold mines in the world and for many years it was the premier mine of the Witwatersrand. During the whole period of its existence to Dec. 31, last, it has milled 11,750,000 tons of ore, which produced 5,840,000 oz. of gold, or an average of nearly 10 dwt. per ton. The total revenue produced from gold recovered was £24,850,000. After providing for working expenditure, the net profits have amounted to £14,418,000 and there has been distributed to shareholders £11,980,937, the difference being due to expenditure on capital account and government and other taxes. The company was a pioneer in gold mining on the Rand. It was one of the first to install Frue vanners, and, in 1891, it established a chlorination plant, with the help of Charles Butters, who was engaged from America to design, erect, and manage the plant. This company was the first to introduce rock drills on these fields in 1891, and was followed by the Ferreira and Crown Reef companies. During the Boer War, 1899-1900, the mine was commandeered by the Republican Government, and 129,310 tons of the best-grade ore were hoisted and treated, producing gold to the value of £430,640. The first consulting engineer, the late Hennen Jennings, was appointed in 1896. Resolutions for the liquidation of the company were moved, seconded, and passed. A further extraordinary meeting will be held to confirm the resolution.

Transvaal Platinum Report Issued

Transvaal Platinum, Ltd., issued a directors' report for the three months ended March 31, showing a total development of 758 ft., of which 444 ft. was done on the farm Rietfontein and 314 ft. on Welgevonden. At Rietfontein the drives east and west on the 100 level from the No. 9 winze were advanced in erratic values, the payable stretches averaged 6.8 dwt. over a width of 25 in. On Welgevonden a stretch of 20 ft. in the drive west from No. 6 winze averaged 19.7 dwt. over a width of 50 in., the rest of the drive being in ore varying from 3 to 6 dwt. Ore valued at 12.8 dwt. over 48 in. was exposed in the east drive from No. 3A winze. From open workings, a total of 651 tons of ore, averaging 10.5 dwt. per ton, was mined. Trial runs of the reduction plant took place during the latter half of March, only low-grade ore being supplied in the initial stages.

On the Johannesburg Stock Exchange, during the last week, the share market was active. London did a large amount of business, more as a buyer than a seller. New Modders for the first time advanced to over £5, and Sub-Nigels advanced, with big business, from 33s. 6d. to 36s. T. C. Lands fell from 53s. 9d. to 48s., and platinum shares were quieter and easier.

Manitoba Properties Refinanced in London

Messrs. A. D. Miles, H. A. Wentworth, and H. C. Davis, of the Anglo-Canadian Explorers, Toronto, Ont., and Central Manitoba Mines, have returned from England, where they went to see John Taylor & Sons, to settle upon further plans for the financing and development of their Manitoba properties. Messrs. Wentworth and Davis represent the WAD Syndicate, which has large holdings in Manitoba. A part of these holdings were incorporated in the Central Manitoba Mines, and an option was taken by the Anglo-Canadian Explorers, which is financed by John Taylor & Sons, of London.

Developments, though very satisfactory, were hardly up to original expectations, and it was considered advisable not only to change the terms of the option, but also to arrange for the inclusion of the ground lying to the east and west of the Central Manitoba group. This arrangement was successfully concluded, and the capital of the company has been increased from 3,000,000 to 4,500,000 shares of $1 par. It is understood that there will be approximately 1,500,000 shares in the Treasury and that sufficient money has been guaranteed to carry on the necessary prospecting and development work throughout the present year.

On the Central Manitoba a shaft has been sunk to a vertical depth of 375 ft., which is equivalent to about 500 ft. on the dip of the vein, and a considerable amount of drifting has been done on the 125- and 375-ft. levels. A winze is now being sunk below the bottom level, and the work accomplished to date shows a good grade of ore. The ground to the west of the Central Manitoba is entirely unprospected, but that lying to the east, and known as the Hope group, has some very good surface showings. It is believed that with the inclusion of the Hope, developments are sufficient to justify the erection of a 200-ton mill. Work on this, however, cannot be started until next winter, as heavy material and equipment can only be brought in over winter roads.

Noranda Options Claims in Gowganda Area

The Noranda Mines, Rouyn, Quebec, has taken an option on the Hylands, Johnston, and Gardner claims, near Gowganda, Ontario, comprising a group of nine claims with a total area of 280 acres, which will be operated by a new subsidiary company. There is already a shaft on the property down to a depth of 100 ft. The new company intends sinking this shaft to the contact, which the operators believe will be reached at a depth of 400 ft. from surface.

London Letter

By W. A. Doman

Special Correspondent

Zinc Syndicate Being Formed—M'Kubwa Copper Mine Begins Operations

London, June 15—According to a message from Cologne, the difficulties in the way of forming an international zinc syndicate which arose in the middle of April through the failure of negotiations between the Belgian Montagne concern and the English interests have been surmounted, the latter having made concessions in the matter of capital holdings. The hope is expressed in Cologne that working agreements with the German zinc industry will before long be concluded.

At yesterday's meeting of the Zinc Corporation, F. A. Govett, the chairman, was not altogether optimistic from the standpoint of the price of metals. He remarked that conditions during 1925 had been much in the corporation's favor, and though it was expected that metal prices would not slump to a dangerous extent it was, in his view, unlikely that last year's average prices for lead and spelter, £35 17s. and £36 5s. respectively, would be maintained. Instead, therefore, of distributing the larger dividends which the financial position enabled the directors to do, it was considered wise to continue to build up the fabric of the company. As there is still scope for metallurgical research, the corporation has, in conjunction with other interested Broken Hill companies and with the Burmah Corporation, erected a pilot plant at the Avonmouth Works of the Associated Smelters for the treatment of lead-silver-zinc ores. Sir Robert Horne has joined the board of the Zinc Corporation.

The new plant at the Bwana M'Kubwa copper mine, Rhodesia, has been started, and the gyratory and coarse crusher unit is reported to be working well. Two preheaters and reducing furnaces are in operation and are averaging 500 tons daily. The fine-crushing plant is also working satisfactorily. Leaching started on June 9, with ore averaging 2½ per cent copper. This low-grade ore was selected for the adjustment of the plant, as the 200,000 tons mined and broken has proved to be slightly higher than originally estimated.

It is reported from Almeria (Spain) that the Maria Josefa mine, in the region of Rodalquilar, contains important auriferous reefs, and furnaces have been erected to treat the ore.

I have previously referred to the Wanderer mine, in Rhodesia, which was closed down some years ago, as the ore yielded only about 8s. 2d. per ton. Within recent months it has been reopened by other persons, and values of from 7.3 up to 18 dwt. have been obtained on a reef with a width of from 10 to 76 ft. Working conditions are said to be similar to those in the Shamva mine. Costs are estimated at 11s. per ton and recovery at 30s. The Goldfields Rhodesian company and the Rhodesia Exploration are supplying the bulk of the capital.

The Indian Copper Corporation requires more capital to install the necessary reduction plant. Up to the present, more than 500,000 tons of ore of between 4 and 5 dwt. has been developed.

Tin Mining Gains

The British Government is taking an interest in the Cornish tin-mining industry. Quite apart from the money it has advanced under the Trade Facilities Act, the Mines Department has issued an appeal to mining engineers and others who may happen to possess plans of the workings of abandoned properties, especially those which had been operated prior to 1873. It is the intention of the government to compile a register of the old plans so that the fullest information would be at the disposal of those who may be interested in the reopening of some of the old Cornish tin mines.

High Tax on Rand

Owing to the high taxation prevailing on the Rand, the loss of the gold premium, and the lower grade of ore now being worked, views are being expressed that the industry is fast declining. And yet the output for last month constituted a record. Apparently some of the leaders of the industry do not entertain pessimistic views, for they point to the way in which costs have been reduced during the last decade, and argue that with mechanical devices, such as are now in operation, expenses can be still further reduced and a lower grade of ore be made profitable. A shilling per ton brings within the payable category millions of tons of ore, so that the end is not yet in sight.

Production of Feldspar in 1925 Declines 10 per Cent

The crude feldspar sold or used by producers in the United States in 1925 amounted to about 184,100 long tons, valued at $1,306,300, according to a statement prepared from reports received directly from producers and issued by the U. S. Bureau of Mines, in co-operation with the geological surveys of Maryland, New York, North Carolina, and Virginia. These figures show a decrease of 10 per cent in quantity and 13 per cent in value compared with those for 1924. The average value per long ton in North Carolina was $6.48; in New Hampshire, $7.28; and in Maine, $9.04.

Buckingham Mina Begins Work on Fifty-Ton Mill

Construction of a new fifty-ton concentrating plant has been begun by the Buckingham Mina Consolidated Mines Co., of Battle Mountain, Nevada. A bunkhouse and storehouse have been completed and several carloads of Oregon pine and timber are being hauled to the property. A carload of cement has already been delivered. Equipment will consist of Blake jaw crushers, a Gibson rod mill, six B. & M. concentrating tables, and a 320-hp. Bolinder oil-burning engine, according to E. A. S. Whittard, manager.

Societies, Addresses, and Reports

Engineering Educators Hear Reports at Iowa Meeting

Co-ordination Feature of Plans—Broadening of Courses Advocated in Constructive Report

The Society for the Promotion of Engineering Education held its thirty-fourth annual convention meeting at the State University of Iowa, Iowa City, June 16 to 18. The attendance was 312, with more than eighty institutions, thirty-eight states, and Canada and Brazil represented. The sudden and untimely death of Dean William G. Raymond of the State University of Iowa on June 17 cast a heavy cloud over the atmosphere of the gathering; all following social features were abandoned, save some functions for the ladies and the annual banquet.

Almost exclusively the set program was devoted to results and interpretation of the findings of the research started some years ago to co-ordinate engineering colleges. The amount of energy expended and the body of fact finding, theory, and synthesis, presented was tremendous. Dean Marston, reporting as chairman of the A.S.C.E. committee on Engineering Education, gave composite results of questionnaires sent to some 1,500 members of A.S.C.E., A.S.M.E., and A.I.E.E. From these, it was apparent that there was a general appeal for broadening of college courses and a tendency to hold to the engineering course, but to have it include some business training. Fewer than half the replies indicated a preference for functional division in courses as opposed to technical division—that is, sales, design, and such as opposed to civil, mechanical, and such.

Careful Selection of Student Material Essential

That guidance of high-school students in choosing engineering as a career should be furnished by conferences of high-school teachers and teachers of engineering, addresses on engineering to high schools, distribution of especially prepared literature to high schools, and dissemination of information by various means, such as radio and extension, was the contention of a portion of a paper on engineering students and graduates. It was pointed out that fewer than half the students entering upon technical courses had any conception of their chosen field.

The matter of elimination of engineering students has attracted a good deal of attention, as evidenced by the repeated queries as to how to remedy the situation in which the eliminations are so numerous as at present, with the too-frequent accompanying personal injury to students. Dean Seashore of the State University of Iowa offered the preliminary placement examinations, which are yearly being improved, as the means by which the student may be warned in advance of entering a course for which he is unfitted. By this method, the matter is handled in a kindly way, the student being shown by the actual evidence that he is unqualified; his aptitude may lie in some particular direction which will be shown in the examination results.

Probably the most important single feature of the convention was the report of the Board of Co-ordination and Investigation. Associate Director Hammond's summary of the fact-gathering stages set forth such a mass of careful, thorough, all-inclusive evidence as to be almost unique in the history of enginering education. Chairman Scott reported on some of the administrative phases of the work. Noteworthy in his statement were the encouragement and appreciation expressed by the various bodies concerned, and their admonition to proceed to the application of the principles evolved from the study.

Director Wickenden made analysis and recommendation on the basis of the facts found in the investigation. His report, throughout, was constructive rather than destructive. The present order, by it, would not be destroyed, or crippled by serious alteration, but rather would be strengthened and amplified until engineering education was more balanced and stabilized in all institutions. By the report, the four-year course, with simplification and unification of subject matter, may be confidently expected to give a good general training upon which to build an intense technical knowledge by graduate study, extension courses, or post-scholastic education.

The technical engineer of today is called upon to be thoroughly trained in one field and intelligent in several allied fields. This demands broad general training, followed by education along with practice. The report repeatedly stressed the fact that concerted action by the colleges is necessary to insure real progress now. It is evident that the colleges alone cannot solve the problem of engineering education, but that the industries, the engineering societies, and the colleges must work together to meet their mutual obligations and serve their mutual interests.

Fall Meeting Scheduled

In the early fall, a group of deans and executive officers will meet to formulate a program of action to reach practices making for further co-ordination in engineering education.

The officers for the coming year are: O. M. Leland, Dean of Engineering, University of Minnesota, president; H. W. Tyler, Massachusetts Institute of Technology, and W. S. Rodman, University of Virginia, vice-presidents; F. L. Bishop, Dean of Engineering, University of Pittsburgh, secretary; W. O. Wiley, treasurer; Miss Sada A. Harbarger, Ohio State; W. K. Hatt, Purdue; E. R. Hedrick, University of California; R. A. Seaton, Dean of Engineering, Kansas State Agricultural College; J. W. Votey, University of Vermont, and S. M. Woodward, State University of Iowa, council.

The next convention of the society will be held at the University of Maine, Orono, Maine.

Changes in Michigan College of Mines Faculty

A number of important changes in the faculty of the Michigan College of Mines, Houghton, were recently announced. F. W. Sperr, for thirty-two years head of the department of civil and mining engineering, was relieved upon his own request of his duties as head of the department and some of his teaching duties. Professor Sperr recently attained the age of 70. George P. Schubert, a member of the faculty for twenty-two years, was promoted to professor of civil engineering. Leo F. Duggan, associate professor in mathematics and physics, was elected professor of mathematics. R. R. Seeber, assistant professor of mechanical and electrical engineering, was promoted to professor of the same subjects.

The following instructors have been advanced to assistant professors in their respective departments: Thomas E. Richards, mechanical engineering; Wyllis A. Seaman, mineralogy and geology; Robert C. Matson, civil and mining engineering; Bart Parks, chemistry; Wilfred C. Polkinghorne, mechanical engineering; and Nicholas H. Manderfield, metallurgy. Andrew T. Sweet was promoted from assistant professor to the head of the department of metallurgy and ore dressing. John L. Young, of the University of Pittsburgh, was elected assistant professor of metallurgy. Leon S. Ward, of the University of Wisconsin, was appointed associate professor of chemistry. The resignations of Dr. Karl S. Means, assistant professor of chemistry, and M. G. Sateren, instructor of mathematics and physics, were accepted.

Golden School Officials Visit Joplin Field

Representatives of the faculty of the Colorado School of Mines recently visited the Joplin-Miami district, and while there attended a special meeting of the Tri-State Operators' Association at Picher, Okla., on June 15, which was called to give the members an opportunity to meet President Coolbaugh, Dean Lester Grant, and Associate Director S. Power Warren, of the school at Golden. President Coolbaugh made an address on the possibility of zinc production from Western complex ores. Dean Grant also spoke on his impressions of the district, and Mr. Warren discussed details of operating plants using differential flotation for the production of zinc concentrates.

Mother Lode Chapter of A.M.C. Elects Officers

The Mother Lode Chapter of the American Mining Congress organized at Sacramento, Calif., on June 12, 1926. Clarence Jarvis was chosen governor of the section, F. C. Stevenot, James Stewart and H. E. Dillinger, vice-governors, and C. G. Johnson, secretary-treasurer. Another meeting will be held on Sept. 15, 1926, at which it is planned to extend the organization to all mining operators on the Pacific Coast.

People You Should Know About

S. F. Shaw is making a trip of inspection to mines in the Mazapil district, Zacatecas, Mexico.

George H. Garrey, who has been in Europe for the past five months, has returned to his Philadelphia office.

Stanly A. Easton, manager of the Bunker Hill & Sullivan properties at Kellogg, was recently in Washington, D. C.

E. H. Snyder, manager of the Combined Metals Reduction Co., operating at Bauer, Utah, is visiting southern Idaho properties.

F. C. Ninnis, superintendent of the West End mill, at Tonopah, Nev., has returned to Tonopah from a trip to Southern California points.

Irvine M. Marshall, assistant professor of mining engineering at the University of Illinois, is making an extended visit in the Rouyn district, Quebec.

Matthew Van Siclen, chief of the Mining Research Division of the Bureau of Mines, has been granted a six months' leave of absence, during which he will familiarize himself with mining methods in several of the countries in Europe.

Arthur W. Stevens, mining engineer, has just completed an examination of the McCarty mine, in Idaho, and has left Boise for Custer County to examine the Williams mine, near the Livingston.

F. W. Bradley, of San Francisco, recently returned from a trip to Kellogg, Idaho, and Spokane, Wash., in the interest of the Bunker Hill & Sullivan Mining & Concentrating Co.

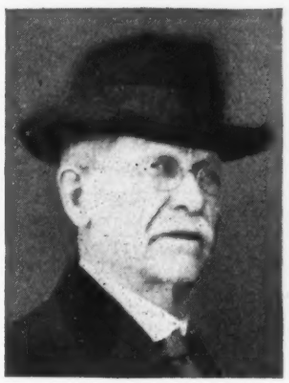
J. B. Mertie, Jr., of the Alaskan Branch of the U. S. Bureau of Mines, left Fort Yukon on Yukon River, Alaska, on June 8 to go up Porcupine and Sheenjek rivers, where field work will begin.

Captain Thomas Rapson, in charge of underground operations at the Ahmeek mine, in the Michigan copper district, since that property was opened, has retired. He has been succeeded by **John Edwards,** who has been in charge of underground work at the Kearsarge branch of Calumet & Hecla Consolidated.

S. R. Capps, of the Alaskan Branch of the U. S. Bureau of Mines, left Anchorage, Alaska, June 10, for field work in the Skwentna River country, where he will be joined by **K. W. Trimble,** in charge of the pack train of the party. Mr. Capp's route will be up Susitna and Yentna rivers; the pack train will go by way of Beluga River.

James MacNaughton recently observed his twenty-fifth anniversary as general manager of Calumet & Hecla Consolidated at Calumet, Mich. Officials of the company pleasantly surprised him with a dinner at the Miscowaubik Club. The guests were officials and department heads who have been employed by the corporation for twenty-five years or more. Mr. MacNaughton was presented with a beautiful silver platter on which the names of the guests were engraved.

Prof. F. W. Sperr, head of the department of civil and mining engineering of the Michigan College of Mines, at Houghton, on the occasion of his seventieth birthday anniversary, June 5, was presented with a book of letters from the alumni, faculty, and students, which was bound in morocco and embossed. The presentation was made at a banquet in his honor by Dr. W. O. Hotchkiss, president of the college. Professor Sperr has been a member of the faculty of the institution for thirty-two years. Professor Sperr was graduated from Ohio State University in 1883, receiving the degree of E. M. He engaged as a mining engineer and mine operator in Colorado, Arizona, and Mexico from 1883 to 1888. From 1888 to 1894 he was assistant professor of mining engineering at Ohio State University, and in 1894 came to the Michigan College of Mines to take charge of the work in ore dressing and civil and mining engineering. Despite his advanced years, he continues active, as indicated by the fact that he recently made his thirty-second consecutive mining trip with a class of students to the Michigan iron ranges. Aside from his educational work, Professor Sperr is active in affairs relating to the mining industry. He is a member of the A.I.M.E., the L.S.M.I., and the S.P.E.E., and has served on important committees in these societies.



F. W. Sperr

Obituary

George T. Herbert, mining engineer for the Bethlehem Mines Corporation, a subsidiary of the Bethlehem Steel Corporation, died at Lebanon, Pa., on June 21. He was twenty-seven years old. Mr. Herbert was the son of Mr. and Mrs. Charles G. Herbert, 410 Riverside Drive, New York City, and a brother of Charles V. Herbert.

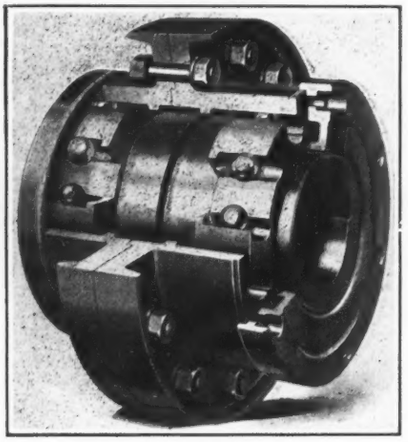
Camille Covallier, who had been long a distinguished figure in the metallurgical industries of France, died at Nancy, France, on June 10. He was seventy-three years old. M. Covallier was president of the Société Anonyme des Hauts-Forneaux et Fonderies du Pont-a-Mousson. He was an officer of the Legion d'Honneur, and had extensive interests in many French mining and industrial companies.

Earl W. Oglebay, the founder of Oglebay, Norton & Co., and long prominently identified with the Lake Superior iron country, died on June 22, in his seventy-seventh year. In addition to his connection with the above-named company, Mr. Oglebay had extensive interests in many manufacturing and transportation corporations. For nearly fifty years he had been president of the National Bank of West Virginia, at Wheeling.

Cleveland H. Dodge, vice-president of the Phelps Dodge Corporation, and a prominent figure in the business, social, and civic life of New York City, died at his home in Riverdale, N. Y., on June 24, in his sixty-seventh year. Mr. Dodge was a classmate of President Wilson at Princeton and had taken a prominent part in the Red Cross and other philanthropic work during the period of the Great War. He was of old American stock, his family having come to the United States and settled in Salem, Mass., in 1629. Mr. Dodge's grandfather was one of the founders of Phelps, Dodge & Co., one of the greatest metal houses in the industry. Mr. Dodge is survived by two sons, Bayard Dodge and Cleveland E. Dodge.

William Jamieson, a pioneer of the famous Broken Hill mineral field of New South Wales, Australia, died on May 8 in Melbourne. Mr. Jamieson, who had reached the age of seventy-three, arrived in Victoria from Scotland when a lad of sixteen. After obtaining a technical training, he was for a time in the employ of the New South Wales Government as a surveyor, and in this capacity had charge of the Silverton district, which embraced the Broken Hill mineral region. In 1883 he first visited "the Hill," of which he made an examination, and bought what was then considered a small interest in the parent mine. In 1885 a syndicate, of which Mr. Jamieson was one, was floated into the first Broken Hill Proprietary Company, with a capital of £320,000. Of this company he was appointed the first manager. Twelve months later he, with another shareholder, visited Europe and America to find a general manager and a metallurgist for the company, and selected for those respective positions W. Paton and H. H. Schlapp. With the then government surveyor, Mr. Jamieson chose the site of the Broken Hill township. From 1889 till 1892 he was on the London board of the Broken Hill Proprietary Company. He then returned to Melbourne, where he lived till his death, and where he was regarded as a pillar of strength on the Australian directorate of the company. In 1911 he, with his co-directors, initiated the big scheme which resulted in the iron and steel works enterprise of the Broken Hill company at Newcastle, New South Wales. Mr. Jamieson was also one of the first directors of the Mount Lyell company, Tasmania, and held that position, too, until his death. In addition, he at different times was a director of several other mining companies operating in New South Wales, Victoria, and other parts of Australia.

New Machinery and Inventions



Partial cross-section of flexible coupling

Transmits Power with Shafts Out of Line or Offset

In the accompanying illustration may be seen a partial cross-section of the new Sykes universal flexible coupling, manufactured in sizes from ¾ to 8 in. by the Farrel Foundry & Machine Co., Inc., of Buffalo, N. Y. This device is practically a ball-bearing, universal joint capable of transmitting motion between shafts as much as 5 deg. out of line or offset as much as 4 per cent of the shaft diameter. In either case the movement of the balls upon their races is slight, never exceeding 1/32 in. per revolution.

Simplicity of construction is a distinguishing characteristic of this new coupling. It is composed of three main members—two hubs keyable to the ends of the driving and driven shafts respectively, and a two-piece sleeve inclosing and covering the whole device. Each hub carries ball races arranged around its periphery which match similar races on the inner surface of the sleeve sections. The balls, which are of standard sizes such as are used in bearings and journals, are placed between or within the races thus formed.

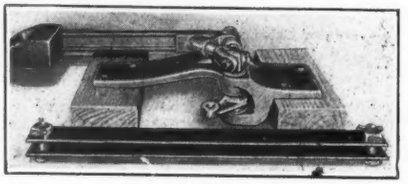
Analysis of the action of this coupling shows that irrespective of the amount of misalignment of one shaft with respect to the other the balls always maintain line contact with the races. Lubrication of this coupling is of minor importance. Because of the large area of ball contact and the small and comparatively slow movement of the balls a thin film of grease on each is all that is necessary. In fact the coupling may be run for long periods entirely "dry" without appreciable damage.

Parallel-Throw Switch Is Low, Compact, and Durable

Designed to afford maximum service at minimum cost, the new parallel-throw switch stand shown in the accompanying illustration has been placed on the market by the West Virginia Rail Co., of Huntington, W. Va. This stand is made in two sizes, the first intended for rails weighing up to 40 lb. per yard and the second for those weighing 45 to 60 lb. per yard. Both crank and lever shafts are supported by double bearings. In consequence none of the working parts overhang and the inevitable bending stress and wear are avoided.

All bearings are reamed from the solid metal, assuring the best conditions for slow-moving journals. The design is such that an increasing pressure is applied to the switch points at the extremities of the throw. The stand is low, thus offering a minimum of obstruction. When equipped with a rigid connecting rod as shown in the illustration the device is self-locking.

A hexagonal hole in the crank accurately fits the hexagon steel crankshaft, making transmission of the turning movement positive. The crank is placed at such a height as to be in alignment with the switch bar, thus avoiding offsets and consequent bending stresses in the connecting rod. As a special safety connecting-rod bolt is used to hold the rod, both stand and switch points are protected from breakage should a trip run through the switch, provided the rod is of the rigid type. This bolt is easily replaceable when broken or sheared. The entire stand is made of steel and malleable iron, and is thus extremely strong and durable.



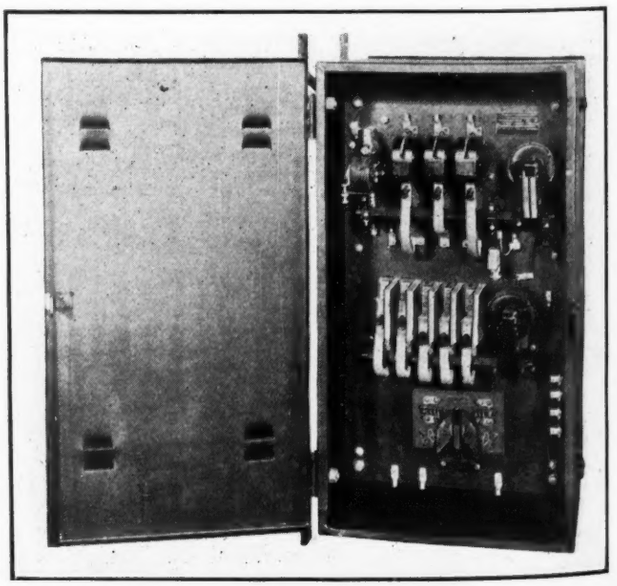
Switch stand and rod

New A. C. Starter Introduced

A new starter has been announced by the General Electric Co. (type CR-7055-A-1). It is a reversing primary resistor starter for squirrel-cage induction motors. Two three-pole line contactors are provided with it. These are electrically and mechanically interlocked and are mounted back-to-back on the panel. A magnetic time interlock provides a predetermined definite time of from one to three seconds between the closing of the line contactor and of the accelerating contactor. Two-point starting is provided by a resistor designed to conform to Electric Power Club classification No. 16. A temperature overload relay with an external resetting mechanism furnishes overload protection.

The inclosing case is of sheet metal, semi-ventilated, and is provided with feet for wall mounting. When mounted, the panel occupies a position at right angles to the wall. Doors may be locked and are provided at front and back of the panel.

This reversing primary resistor starter for squirrel-cage induction motors is enclosed in a sheet-metal case equipped for wall mounting



Trade Catalogs

Vacuum Pumps—Bulletin 20B of the Connersville Blower Co., Connersville, Ind., is a recently revised edition descriptive of Connersville cycloidal vacuum pumps with two-lobed impellers, these pumps being suitable for processes requiring normal vacuums of 15 in. or less, with a maximum of 20 in.

Nickel—Bulletin 201 of the International Nickel Co., 67 Wall St., New York, on "Properties and Applications of Nickel and Nickel-Chromium Cast Iron," is a 4-page 8½ x 11 in. pamphlet perforated for binding, in which are tabulated the improvements to be secured by the addition of nickel or nickel and chromium to cast iron; a summary of the savings effected; a partial list of applications, and a list of materials available for making the alloy addition. Six illustrations of typical nickel-cast-iron applications are shown, each with a brief description. Another bulletin, No. 202, on "Improving Gray Cast Iron With Nickel," is a 12-page 8½ x 11-in. bulletin perforated for binding, in which all essential information required by the foundryman, metallurgist, or engineer is presented in brief form, with tables, illustrations, commercial applications, and instructions for making the nickel or nickel and chromium addition.

The Market Report

Non-Ferrous Metal Markets Steady

Copper Prices Droop, but Lead, Zinc, and Tin Show Little Change—Silver Quiet and Steady—Antimony Picks Up

New York, June 30, 1926. — Except for an easing tendency in copper, little or no change has occurred in the non-ferrous metal markets during the week ending today. The volume of sales in copper has been unusually light, but lead has been active and the other metals can by no means be called dull, taking the week as a whole. Today consumers have shown less interest; apparently many purchasing agents expect to make a full week of it over the first of the month and the Fourth. London prices have likewise remained steady. The coal strike is now in its third month, and the impression seems to prevail that a settlement will soon be reached. Unquestionably the strike has caused a drastic curtailment in manufacturing activity, and a conclusion of it is viewed as a bullish factor in all the markets. A factor in the domestic market is the optimism generated by the reaching of a new high record for the shares of United States Steel

Daily Prices of Metals

June	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
24	13.625@13.75	59.25	61.625	8.25	8.10	7.175@7.225
25	13.625@13.75	59.375	61.875	8.25	8.10@8.125	7.175
26	13.625	59.375	61.875	8.275	8.10	7.15
28	13.60@13.625	59.00	61.375	8.275	8.10	7.10@7.15
29	13.60@13.625	59.25	61.75	8.275	8.05@8.125	7.175
30	13.60@13.625	59.00	61.50	8.25	8.10	7.20
Av.	13.640	59.208	61.667	8.263	8.100	7.171

The prices correspond to the following quotations for copper delivered: June 24th and 25th, 13.875@14c.; 26th, 13.875c.; June 28th, 29th and 30th, 13.85@13.875c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

June	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
24	56 3/4	57 5/8	64 1/2	272 3/4	272 1/4	30 1/8	30 3/16	33 11/16	33 1/2
25	56 3/4	57 5/8	64 1/2	273 5/8	273	29 7/8	29 15/16	33 7/16	33 1/2
28	56 5/8	57 1/2	64 1/2	272	271	29 7/8	29 7/8	33 3/16	33 5/16
29	57	57 3/4	64 3/4	272 1/4	271 5/8	30 3/16	30 3/16	33 5/8	33 5/8
30	56 7/8	57 3/4	64 3/4	272	271 1/2	30 1/16	30 1/16	33 11/16	33 11/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

June	Sterling Exchange "Checks"	Silver		Gold London	June	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
24	4 86	65 1/2	30 1/4	84s11 1/2d	28	4 86 1/16	65 3/8	30 3/16	84s11 1/2d
25	4 86	65 3/8	30 3/16	84s11 1/2d	29	4 86 1/8	65 3/8	30 1/4	84s10 1/2d
26	4 86 1/8	65 3/8	30 3/16	.....	30	4 86 1/8	65 1/2	30 3/16	84s11 1/2d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Average Metal Prices for June, 1926

Copper:	
New York Electrolytic	13.656
London Standard Spot	56.778
London Electrolytic Spot	64.591
Lead:	
New York	8.033
St. Louis	7.876
London Spot	29.986
London Forward	30.142
Silver:	
New York	65.481
London	30.248
Sterling exchange	486.000
Zinc:	
St. Louis	7.112
London Spot	33.244
London Forward	33.398
Tin:	
99 per cent	58.409
Straits	60.611
London	268.352
Quicksilver	91.346
Antimony	11.106
Platinum:	
Refined	111.000
Crude	106.615
Aluminum, 98 per cent	27.000

Copper Close to 13.875c.

The week in copper has been even duller than the very dull week that preceded it. Since Monday there has been a tendency to shade 13.875c. delivered by one or two sellers, but others have obtained the even eighth, and one sale in the East brought 13.90c., with 14c. realized in the Middle West. Export business likewise has been conspicuously dull, with 13.75c. and 13.80c. f.a.s. and 14.05c. c.i.f. being done. There seems little pressure to sell on the part of producers, and at least three of them are virtually out of the market at current prices. What little demand there is seems to be for July delivery.

The increased freight rates on shipments of refined copper to consuming points are scheduled to go into effect tomorrow, July 1. Producers some time ago made formal protest on technical grounds, and in some quarters it is expected that a last-minute order will be issued, suspending the rates until further notice. As we go to press telegraphic reports from Washington announce a suspension until Oct. 29.

The Copper Export Trading Association, which everyone expected would start operations on July 1, has apparently found some clouds on the horizon, for word is being passed around that launching will be deferred till Fall. No reason is assigned for this change of plans, but it is intimated that the failure of Congress to adjourn has been

at least a contributing factor to the postponement. Traders and dealers in London are said to be upset over the change.

Lead Buying Brisk

Lead business has been excellent all week, both in New York and in the St. Louis district, although one producer is inclined to call the market weaker in the West the last two days. Paint-making interests have been more active during the last week than for several months past, and the demand for corroding grade consequently has been good. Premiums over the 8.25c. price officially quoted by the American Smelting & Refining Co. during the week have been obtained in some instances for delivery in the New York market. On the other hand, several lots of July metal were sold in St. Louis at 8.05c. London is so far below parity with New York that foreign ore lead is all coming into the United States, but apparently there is little difficulty in absorbing it in the domestic market. Virtually all of the sales have been for July delivery, with an occasional lot for August. In one instance a premium was obtained for forward delivery. Producers in the Joplin district, unwilling to sell concentrate at $100 per ton and unable to obtain more, are said to be accumulating quite a supply of concentrate, apparently anticipating some improvement in the quotations for the metal.

Zinc Sags and Comes Back

On Saturday and Monday the zinc market developed weakness, but with improvement in the London market and a fair volume of buying on the part of domestic consumers prices have again stiffened. Galvanizers are the principal buyers, and their requirements for immediate shipment seem to be urgent. One of the principal producers of galvanized sheets declares that sales in recent weeks have been at a rate equivalent to the full capacity of its plants. High Grade is quoted at 8.50c. in New York, with a moderate demand. Reports from Joplin are to the effect that a shutdown of at least a week over the holiday will curtail production for the month by 25 per cent, and this is credited with helping the improvement in the price for the metal.

Tin at 61.50c. per Pound

Fair activity has marked the domestic tin situation, though prices are a trifle easier today. Deliveries in the United States for June exceeded 6,900 tons, a figure higher than that of any June in the last ten years. A contraction in consumption in the United Kingdom, however, is a contributing factor to the increase here. Shipments of Chinese and Banka metal in June were exceedingly small, totaling only 716 tons. Premium for Straits over 99 per cent was from 2¼ to 2⅜c. and the premium on prompt Straits is nearly a cent over October delivery.

Francs Improved During Week

French francs during the week went up and then down. Sterling continues strong, but there are no significant developments in the foreign exchange market. Closing cable quotations on Tuesday, June 29, are as follows: francs 2.88c.; lira 3.62c.; and marks 23.81c. Canadian dollars are at a premium of 3/32 per cent.

Silver Steady and Firm

The market contines quiet and steady, with very small fluctuations—only ⅛d. in London and ⅛c. in New York during the last week. India has shown little interest, and London reports China a seller as well as a buyer, although rates for San Francisco delivery have been well maintained.

Mexican Dollars (Old Mexican pesos): June 24th, 50¼c.; June 25th, 26th, 28th, 29th, 50⅜c.; June 30th, 50¼c.

Steel Steady and Strong—Pig Iron and Coke Quiet

Pittsburgh, June 29, 1926

The steel market as a whole has been turning somewhat quieter in this latter part of June, but there has been such an increase since the fore part of April that there is in present circumstances little reflection of the summer dullness usually expected. Some of the recent buying may have been covering for the vacation period, so that the month of July itself may be dull.

Pig Iron — Surrounded by districts with more or less buying, yet with the lowest prices in the country, the Valley market remains quiet, though not altogether as stagnant as a few weeks ago. Several furnaces are likely to go out. Prices are unchanged at $19 for bessemer and $18 for basic, foundry and malleable, f.o.b. Valley furnaces.

Connellsville Coke—There has been just a little more contracting, the total volume on the movement being disappointing. Spot furnace, $2.75; spot foundry, $4@$4.50.

Zinc Blende and Lead Ore Prices Unchanged

Joplin, Mo., June 26, 1926

Zinc Blende	Ton
High	$52.30
Premium blende, basis 60 per cent zinc	$49.00@50.00
Prime Western, basis 60 per cent zinc	48.00
Fines and slimes, 60 per cent zinc	47.00@44.00
Average settling price, all zinc	46.41
Galena	
High	$100.60
Basis 80 per cent lead	100.00
Average settling price, all lead	97.91

Shipments for the week: Blende, 17,447; lead, 2,053 tons. Value, all ores the week, $1,010,780.

Shipments six months: Blende, 412,470; lead 59,355 tons. Value, all ores six months, $26,936,380.

Rumors of a basis price higher than $48 remain unconfirmed, and several holders of large tonnages of blende are known to have declined that price offering, and buyers secured only 12,550 tons today, going some 3,000 tons short of the need to supply the smelting capacity.

Production of zinc concentrate has increased this week, being 1,400 more than at the end of May, but is still short of smelting requirements. Stocks were lowered 3,000 tons this week by the heaviest shipment since April 17.

Producers of lead are still declining to accept $100 basis and are holding 17,000 tons for a price they claim should be paid on the market quotation of pig lead. Production is approximately 2,200 tons per week, about 330 tons more than the average shipment of June.

Platteville, Wis., June 26, 1926

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$50.50
Lead Ore	
Lead, basis 80 per cent lead	$100.00

Shipments for the week: Blende, 937 tons; lead, none. Shipments for the year: Blende, 26,216; lead, 672 tons. Shipments for the week to separating plants, 2,007 tons blende.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—Per pound, 99 per cent, 28c.; 98 per cent, 27c. London, 98 per cent, £118 long ton. Domestic demand good.

Antimony — Per pound, New York, duty paid: Chinese brands, spot, 12@13½c.; August arrival, 13c. Cookson's "C" grade, spot, 20⅜c. Market mostly nominal.

Chinese needle, lump, 11c. Standard powdered needle, 200 mesh, 13c. White oxide, Chinese, 99 per cent Sb_2O_3, 14c. Nominal; little business, but outlook seems better.

Bismuth—Per pound, New York, in ton lots, $2.70@$2.75. London, 10s.

Cadmium—Per pound, New York, 60c. London, 1s. 11d. for American metal; 1s. 9d. for Australian metal.

Cobalt—F.o.b. Canadian works, per pound, shot, 96@98 per cent, $2.50@$2.65. Black oxide, 70 per cent, $2.10; gray oxide, 75 per cent, $2.25. London, 10s. for metal; 8s. for black oxide; 8s. 10d. for gray. Market for metal dead; price nominal.

Germanium Oxide—Per gram in 25 to 50 gm. lots, $6.

Iridium—Per ounce, $125@$135 for 98@99 per cent. Nominal. London, £63@£65 in iridio-platinum.

[1]**Lithium**—Per pound, 95@96 per cent grade in 1 to 5 lb. lots, $65.

Magnesium—Per pound, in ton lots, ingot, 75@80c. depending on quality; best 99.8 per cent. Quiet market; prices firm.

London, 3s. 9d.@4s. 3d. for 99 per cent ingots or sticks.

[1]**Molybdenum**—Per kilogram, 99 per cent, $25; C. P. metal, $80.

Monel Metal — Base price for shot, 32c. per pound.

Nickel—Per pound, ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). London, £170@£175 per long ton according to quantity.

Osmium—Per ounce, $65@$75; London, £17@£20.

Palladium—Per ounce, $70@$72. As a constituent of crude platinum, $60@$65 per oz. London, £12@£15, nominal.

Platinum—Refined, per ounce, $114 officially quoted. Sales also at $110@$111. Crude, $109. Market has stiffened in the last few weeks; better buying.

[1]Price furnished by Foote Mineral Co., Philadelphia.

London, £22½@£23½ per ounce for refined, and £21 for crude. Demand limited.

Quicksilver—Per 75-lb. flask, $91@$91.25. London, £15. San Francisco wires $90.67. Market is firm for futures; weaker for spot.

Radium—$70 per mg. radium content.

Rhodium—Per ounce, $70@$80; London, £14@£17. Nominal.

Ruthenium—Per ounce, $60@$70, nominal. London, £12@£15.

[1]**Selenium**—Black powdered, amorphous, 99.5 per cent pure, $2 per pound in ton lots.

Tantalum—Per pound, $36.

Tellurium—Per pound, $2.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $8 per pound in 25-lb. lots.

Tungsten Powder—Per pound, 97 to 98 per cent pure, $1.10@$1.15.

[1]**Zirconium Metal**—Per pound, 98 per cent grade, $30 in 5 to 10 lb. lots.

Metallic Ores

Chrome Ore—Rhodesian, Indian, New Caledonian, 46-50 per cent Cr_2O_3, $21@$23, c.i.f. Atlantic seaports; fair demand.

Iron Ore—Lake Superior ores, per long ton, lower Lake ports:

Mesabi, non-bessemer, 51½ per cent iron, $4.25. Old Range, $4.40.

Mesabi, bessemer, 51½ per cent iron, $4.40. Old Range bessemer, 51½ per cent, $4.55.

High-phosphorus foundry, over 0.18 per cent P, $4.15.

Eastern ores, cents per unit delivered at furnaces: Foundry and basic, 53 to 63 per cent, 9@10½c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

Swedish and Norwegian, low-phosphorus, 68 per cent, 10¼@10¾c.

Spanish low-phosphorus, 52@54 per cent, 10@11c.

Algerian, low-phosphorus, 9¼@9¾c.

Spanish foundry or basic, 50@54 per cent, 8½@9½c.

Swedish foundry or basic, 66@68 per cent, 9@9½c.

Manganese Ore—Per long ton unit of Mn, c.i.f. North Atlantic ports: Brazilian, 40c., nominal; Indian, 40c., nominal; Caucasian (washed), 53 to 55 per cent, 40c.; market dull.

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian and Cuban, $70@$80 per ton in carloads.

Molybdenum Ore—Per pound of MoS_2 for 85 per cent MoS_2 concentrates f.o.b. mines, 65c. Largely nominal.

Tantalum Ore—Foreign, 55@65c. per lb. of Ta_2O_5 contained, c.i.f. New York.

Tungsten Ore—Per unit of WO_3, N.Y.: Wolframite, $10.50@$10.60; Western scheelite, $10.75@$10.85. Domestic demand very light, and prices largely nominal. Large stocks on hand but firmly held for advance in price.

Uranium Ore—Minimum 5 per cent U_3O_8, per pound of U_3O_8 contained, $5, f.o.b. Montrose, Colo.

Vanadium Ore—Containing 5 per cent V_2O_5, 30@35c. per pound of V_2O_5, f.o.b. Montrose, Colo. Market narrow.

Foreign concentrate (lead vanadate) 12 to 18 per cent V_2O_5, 60@65c. per pound V_2O_5, duty paid, seaboard.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]**Amblygonite**—8@9 per cent lithium oxide, $50@$60 per ton, f.o.b. mines.

Asbestos—F.o.b. *Quebec* mines, tax and bags included, per ton:

Crude No. 1, $525; crude No. 2, $300; spinning fibers, $190; magnesia and compressed sheet fibers, $125@$150; shingle stock, $70; paper stock, $40@$45; cement stock, $25; short fibers, $10@$17.50; floats, $15.

Shipments about normal except for falling off in cement and short grades. Prices unchanged.

No. 1 Rhodesian crude, $325; No. 2, $250 per ton, c.i.f. New York. Market good, with principal producer well sold ahead.

Barytes—F.o.b. mines, per ton, bags extra:

South Carolina: Crude, $7@$8 per gross ton; ground, off color, $14@$17 per short ton.

North Carolina: White bleached, $22 per short ton; white natural, $20.

Georgia: Barytes ore, washed, $7.50. Demand good.

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $8, f.o.b. mines. Market good.

Bauxite — American, f.o.b. shipping point per gross ton: Crushed and dried, $5.50@$8.50; pulverized and dried, $14; calcined, crushed, $17@$20.

Foreign, per metric ton, c.i.f.: Dalmatian, low SiO_2. $5@$6.50; Istrian, $5.50@$7; French, red, $6@$7.50.

Prices are largely nominal, as contracts cover most of the 1926 deliveries.

Borax—Carload lots, in bags, per lb.: crystals, 5c.; granulated or powdered, 4¾c.; f.o.b. plant, *Illinois*.

[1]**Celestite**—90 per cent $SrSO_4$, finely powdered, $27 per ton in carload lots.

Chalk—Crude, in bulk, per ton c.i.f. New York, $4.75@$5.

Strike of French longshoremen has cut shipments in last month and price may be increased.

China Clay (Kaolin)—F.o.b. *Virginia* mines, per ton: crude, lump, No. 1, $7; crude No. 2, $5.50; washed. $8; powdered and air-floated, $10@$20; ground, $7@$10.

Florida, pressed pottery, bulk, $13; dry, pulverized, $17.

1A grades, domestic, $16@$18, f.o.b. *Delaware* plants. Market fair.

Imported English, f.o.b. American ports: Pottery, white ware, $19@$22; paper clay, $18. Coal strike has interfered with shipments and increased prices.

Diatomite—Per short ton, f.o.b. plant, *California:*

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $30; natural aggregate, ¼ in.. $20; air-floated powder, $40. Over 85 per cent silica, 98 per cent through 200 mesh, $14.50@$16 depending on quantity; market good.

Emery — F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per pound: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 5½c.; domestic, 3½c. Market good.

Feldspar — F.o.b. mine or grinding plant:

North Carolina: No. 1 pottery grade, $6 per long ton, depending upon quality. Market dull.

New Hampshire: No. 1, not over 10 per cent SiO_2, $8.50 per short ton; pottery grade, $7.50. Ground, $17. Market fair.

New York: Per ton, f.o.b. cars, No. 1 crude, $9. Market good.

Maine: No. 1, ground, $19 per ton. Market good.

Tennessee: No 1 pottery; 140 mesh, $16; 200 mesh, $18. No. 1 enamel, 140 mesh, $14; 200 mesh, $16. Market irregular. Buyers inclined to look at price rather than quality.

Maryland: 140 mesh, $18@$22; 120 mesh, $16; 60 to 100 mesh, $12@$15.

Fluorspar—F.o.b. *Kentucky* and *Illinois* mines, per short ton:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $18. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50. Acid lump, 98-1, $30 in car lots. Acid ground packed in bags, $40@$45. Better tonnage moved during second quarter. Big buyers of gravel spar holding off. Prices firm and unchanged.

New Mexico: 85-5 gravel, $15.75: 90-5 lump, $18 f.o.b. mines. Ground, 96 per cent through 100 mesh, $35. Market good.

Fuller's Earth—Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 60 to 100 mesh, $15; 100 mesh "up," $8; 200 mesh "up," $15. Market fair.

Powdered, imported, duty paid, $23@$25 per ton.

Garnet — Domestic, per ton f.o.b. mines, $85.

Spanish grades, $60, c.i.f. port of entry.

Gilsonite—Per ton, carload lots, f.o.b. mines *Colorado:*

Jet asphaltum, $36; selects, $33; seconds (mine run), $25.50. Market normal.

Graphite—F.o.b. New York, per lb.:

Ceylon lump, 7@9½c.; chip, 6½@8c.; dust, 3¼@6½c. Madagascar flake, 6½@7½c.

Market very quiet; prices for imported product lower.

Flake, 10@20c. according to grade; fine ground crystalline, 7@10c.; amorphous ground graphite, 4@8c. Crude amorphous graphite, $15@$35 per ton according to grade. Market easier.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Greensand—Per ton, f.o.b. cars, *New Jersey:* screened and bagged, best grade in carload lots, $30. Shipments in smaller volume.

Gypsum—Per ton f.o.b. mill, depending upon location: Crushed, $2.75@$3; ground, $4@$6; agricultural, $6@$11; calcined, $8@$12.

[1]**Ilmenite**—Concentrates, 52 per cent TiO_2, 1½c. per lb., f.o.b. *Virginia* points. $60 per short ton, *Florida* mines.

Iron Oxide (See Ocher)—Standard Spanish red, 3@4c. per lb.; domestic earth, 2@4½c.

Kaolin—See China Clay.

[1]**Lepidolite**—$20@$30 per ton for ordinary grades. Nominal.

Limestone—F.o.b. shipping points, depending on location: crushed, ½ in. and less, 90c.@$1.80; 3 in. and larger, 90c.@$1.80 per ton.

Agricultural, $1.35@$5 for pulverized; 75c.@$2 for crushed. Prices depend upon source, purity, and fineness.

Magnesite—Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $40; grade B, $38; dead burned, $35; crude, $14. Market good.

Mica—F.o.b. plant, per ton:

North Carolina: 20 mesh, roofing, $38; 100 mesh, white ground, $70. Market fair.

New Hampshire: Mine run, $360, clean shop scrap, $24@$25; mine scrap, $20. White, dry ground, 20 mesh, $35; 40 mesh, $45; 60 mesh, $60; 100 mesh, $75; 200 mesh, $85. Market slow. Prices easier.

Madagascar, amber, dark, free from iron, per lb., f.o.b. *New York*, duty paid: special grade, $3@$3.25; No. A 1, $2.80; No. 1, $2.60; No. 2, $2.20; No. 3, $1.30; No. 4, 70c. No. 5, 45c.@49c. Grades depend on size of sheets. Market slow but prices firm.

[1]**Monazite**—Minimum 6 per cent ThO_2, $120 per ton.

Ocher—F.o.b. *Georgia* mines, per ton: $22.50@$25 in sacks; $25@$30 in barrels; washed and water floated, $25@$28; second grade, 99 per cent through 225 mesh, $19. Market good.

Phosphate—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10. Market firm with good demand especially for the lower grades.

Florida, pebble, domestic: 76@77 per cent, $6; 75 per cent, $5.25; 74@75 per cent, $5; 70 per cent, $3.50; 76@78 per cent special, $6.50. Prices cover shipments on contract for remainder of 1926 and all of 1927.

Tennessee, lump, ¾-in. screen, base 75 per cent, $6. Ground, 95 per cent through 100 mesh, base 65 per cent, $7.25; asking price advanced to $8 on June 15, but no business at that figure. Market slow, but orders for fall shipment are good.

Potash—	Bags	Bulk
Muriate of potash 80@85 per cent, basis 80 per cent	$34.90	$33.65
Sulphate of potash 90@95 per cent, basis 90 per cent	45.85	44.60
Sulphate of potash-magnesia 48@53 per cent, basis 48 per cent	26.35	25.10
Manure salt 30 per cent	21.00	18.00
Manure salt 20 per cent	14.85	11.85
Kainit 14@16 per cent	11.75	8.75
Kainit 12.4 per cent	11.25	8.25

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

Discounts: 5 per cent on minimum of 50 tons K_2O; 6 per cent on 100 tons; 7 per cent on 300 tons; 10 per cent on 500 tons. Prices guaranteed against sellers' decline until April 30, 1927.

Pumice Stone—In barrels, per lb., powdered, 2½@4c.; selected lumps, 5@7c.; lumps in bags, 3@5c.

Pyrites—Tharsis, per long ton unit of sulphur, c.i.f. U. S. ports; guaranteed 48 per cent sulphur, furnace size, 13½c. Cinder from ore to remain property of buyers. Market improving.

[1]**Quartz Rock Crystals**—Colorless, clear and flawed, pieces ¼ to ½ lb. in weight, 40c. per lb. in ton lots. For optical purposes, double above prices.

Rutile—*Virginia*, per lb.; granular, 94@96 per cent TiO_2, 12@15c.; pulverized, 100 mesh, 94@96 per cent, 17@30c.

Florida 93 per cent TiO_2, $200 per ton.

Silica—Water ground and floated, per ton in bags f.o.b. Illinois: 400 mesh, $31; 350 mesh, $26; 250 mesh, $18.

Glass sand, f.o.b. producing plant, $1.25@$5 per ton; brick and molding sand, 40c.@$2; blast sand, $2@$4.50.

[1]**Spodumene**—$20@$30 per ton, depending upon lithium content. Nominal.

Sulphur—$18 per ton for domestic, f.o.b. *Texas* mines; $22 for export, f.a.s. Atlantic ports. Good shipment against contracts. Open prices $1 higher.

Talc—Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $11; 96 per cent through 200 mesh, medium white, $10; packed in 50-lb. paper bags. Demand fair, buyers reluctant to anticipate requirements.

New York: Double air-floated, 100 mesh, $11.25; 200 mesh, $13.75; 325 mesh, $14.75. Demand fair.

Georgia: Powdered, gray, $7.50@$10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9. Market fair.

New Jersey: Soapstone, ground, $8.50@$10.25; market good.

Tripoli—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri*: Once ground through 40 mesh: rose and cream colored, $16. Double ground through 110 mesh: rose and cream, $17. Air-floated through 200 mesh: rose and cream, $25; mill run, $15. Seasonal slackness.

[1]**Zircon**—Freight allowed east of Mississippi River: 95 per cent, 3c. per lb., f.o.b. mines, in carload lots.

Mineral Products

Arsenious Oxide (white arsenic)—3½c. per lb. Several car lots sold. London, £14@£14½ per long ton.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Copper Sulphate—Large crystals, 4.85@4.95c. per lb. depending on quantity; small crystals, same. Prices advanced.

Sodium Nitrate, spot, crude $2.50 per 100 lb. ex vessel, Atlantic ports. Futures, $2.33@$2.36. Prices recently cut about 10c. per 100 lb.

Sodium Sulphate (Salt Cake)—Per ton, bulk, f.o.b. works, $20@$22.

Zinc Oxide—Per lb. in bags, in car lots: Lead-free, 7½c.; 10, 20 or 35 per cent leaded grades, 7½c.; French, 10½c.

Ferro-Alloys

[1]**Ferrocerium**—Per pound, $5.50.

Ferrochrome—1@2 per cent carbon, 23@25c. per lb. of contained chromium; 4 to 6 per cent carbon, 10½@11½c. per lb.; 0.1 per cent, 35c. per pound. Market fair.

Ferromanganese—Domestic, 78@82 per cent, $88@$90 per gross ton furnace, prompt and future. British product held at $110, seaboard, duty paid. Spiegeleisen, 19@21 per cent, $33 f.o.b. furnace; 16@19 per cent, $32.

Ferrophosphorus—Electrolytic, 18 per cent P, $91 per ton; 24 per cent, $122.50; f.o.b. Ala. and Tenn.

Ferrosilicon—Per gross ton, f.o.b. works: 50 per cent, $85 delivered in carload lots; 75 per cent, $145; 14-16 per cent, $46. Heavy shipments at reduced price.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten—$1@$1.05 per pound of contained W, f.o.b. works, according to grade. Prices fell off 5c. per pound during June and market is weak.

[1]**Ferro-uranium**—30 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works in 500-lb. lots.

Ferrovanadium—Per lb. of V contained, f.o.b. works, $3.25@$4, depending on grade and delivery.

Metal Products

Rolled Copper—Sheets, 22½c.; wire, 16c.

Lead Sheets—Rolled, 12c.; clipped, 12¼c.

Nickel Silver—29½c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal—Dimension sheets, 19½c. per lb.; rods, 16½c. per lb.

Zinc Sheets—11.25c. per lb., f.o.b. works.

Refractories

Chrome Brick—$45 per net ton, f.o.b. shipping point.

Fireclay Brick—First quality, $40@$43 per M., Ohio, Kentucky, Central Pennsylvania; second quality, $35@$38.

Magnesite Brick—9-in. straights, $65 per net ton, f.o.b. works.

Silica Brick—$40 per M. Pennsylvania and Ohio; $48@$52 Alabama and Illinois.

[1]**Zirkite**—Powdered, 80 per cent ZrO_2, 2½c. per lb. Brick, straights, 80c.@$1 each.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1925	1926	1925	1926	1925	1926
January	68.447	67.795	32.197	31.322	477.702	485.295
February	68.472	66.773	32.245	30.797	476.886	485.852
March	67.808	65.880	31.935	30.299	477.279	485.606
April	66.899	64.409	31.372	29.682	479.034	485.702
May	67.580	65.075	31.276	30.125	484.960	485.485
June	69.106	65.481	31.863	30.248	485.553	486.000
July	69.442	.....	31.954	.....	485.514	.....
August	70.240	.....	32.268	.....	485.264	.....
September	71.570	.....	32.983	.....	484.270	.....
October	71.106	.....	32.972	.....	483.909	.....
November	69.223	.....	32.155	.....	484.201	.....
December	68.889	.....	31.835	.....	484.538	.....
Year	69.065	.....	32.088	.....	482.426	.....

New York quotations cents per ounce troy, 999 fine, foreign silver. London pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1925	1926	1925	1926	1925	1926
January	14.709	13.822	66.065	59.013	70.607	65.325
February	14.463	13.999	64.714	59.669	69.525	66.375
March	14.004	13.859	62.892	58.603	67.739	65.489
April	13.252	13.706	60.575	57.200	64.194	64.600
May	13.347	13.599	60.131	56.494	63.560	64.313
June	13.399	13.656	59.899	56.778	63.369	64.591
July	13.946	.....	61.467	.....	65.750	.....
August	14.490	.....	61.613	.....	68.169	.....
September	14.376	.....	61.886	.....	67.693	.....
October	14.300	.....	61.977	.....	67.523	.....
November	14.353	.....	61.280	.....	67.893	.....
December	13.866	.....	59.540	.....	65.625	.....
Year	14.042	.....	61.920	.....	66.804	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London		
	1925	1926	1925	1926	1925	1926	1926 3 M
January	10.169	9.255	9.953	9.102	41.443	34.778	34.584
February	9.428	9.154	9.126	8.991	37.944	33.903	33.903
March	8.914	8.386	8.578	8.165	36.804	31.625	31.921
April	8.005	7.971	7.662	7.764	32.791	28.775	29.284
May	7.985	7.751	7.780	7.538	32.283	28.253	28.731
June	8.321	8.033	8.024	7.876	33.479	29.986	30.142
July	8.151	.....	8.054	.....	34.698	.....	.....
August	9.192	.....	9.284	.....	38.188	.....	.....
September	9.508	.....	9.303	.....	38.884	.....	.....
October	9.513	.....	9.299	.....	39.017	.....	.....
November	9.739	.....	9.578	.....	36.872	.....	.....
December	9.310	.....	9.157	.....	34.739	.....	.....
Year	9.020	.....	8.817	.....	36.429	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1925	1926	1925	1926	1925	1926
January	57.692	61.415	58.250	2.275	265.560	282.038
February	56.517	62.653	57.068	63.705	262.181	287.107
March	53.038	63.472	53.733	64.505	245.682	292.288
April	51.380	61.962	52.135	63.389	237.006	281.388
May	53.675	60.165	54.620	62.305	245.476	270.125
June	54.885	58.409	55.957	60.611	252.476	268.352
July	56.683	.....	58.014	.....	258.435	.....
August	56.649	.....	58.190	.....	258.538	.....
September	56.405	.....	58.247	.....	259.182	.....
October	60.462	.....	62.274	.....	277.722	.....
November	62.136	.....	63.304	.....	284.506	.....
December	61.952	.....	62.928	.....	284.920	.....
Year	56.790	.....	57.893	.....	260.974	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London		
	1925	1926	1925 Spot	1926	1926 3 M
January	7.738	8.304	37.917	38.059	37.363
February	7.480	7.759	36.528	36.053	35.956
March	7.319	7.332	35.741	34.090	34.247
April	6.985	7.001	34.644	32.503	32.863
May	6.951	6.821	34.223	32.038	32.413
June	6.990	7.112	34.149	33.244	33.398
July	7.206	.....	34.894	.....	.....
August	7.576	.....	36.691	.....	.....
September	7.753	.....	37.435	.....	.....
October	8.282	.....	39.884	.....	.....
November	8.614	.....	39.039	.....	.....
December	8.565	.....	38.327	.....	.....
Year	7.622	.....	36.624	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) Refined New York		Platinum (c) Crude New York
	1925	1926	1925	1926	1925	1926	1926
January	17.428	23.490	81.596	87.960	117.000	118.200	113.20
February	19.795	21.676	79.386	87.580	117.000	113.909	108.341
March	15.553	19.708	80.481	88.194	117.000	112.000	106.278
April	12.553	17.462	82.327	89.769	118.269	111.538	103.731
May	15.770	12.170	81.360	91.365	119.850	108.960	102.900
June	16.500	11.106	83.154	91.346	120.000	111.000	106.615
July	17.779	.....	83.077	.....	120.000	.....	.....
August	17.683	.....	82.317	.....	120.000	.....	.....
September	17.143	.....	81.730	.....	120.000	.....	.....
October	18.029	.....	83.856	.....	120.000	.....	.....
November	20.000	.....	88.250	.....	120.000	.....	.....
December	21.692	.....	90.000	.....	120.000	.....	.....
Year	17.494	.....	83.128	.....	119.093	.....	.....

(a) Antimony quotations in cents per pound for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1925	1926	1925	1926	1925	1926
January	24.66	22.76	23.76	21.76	23.76	22.26
February	24.50	22.76	23.26	21.76	23.76	22.26
March	24.06	22.76	23.06	21.76	22.91	22.26
April	22.89	21.38	21.76	20.66	22.26	21.05
May	21.57	21.12	20.26	19.76	21.16	20.76
June	20.76	.....	19.76	.....	20.11	.....
July	20.76	.....	19.76	.....	20.26	.....
August	20.76	.....	19.76	.....	20.26	.....
September	21.04	.....	20.03	.....	20.50	.....
October	21.50	.....	20.37	.....	20.83	.....
November	22.64	.....	21.58	.....	22.08	.....
December	22.76	.....	21.76	.....	22.26	.....
Year	22.33	.....	21.26	.....	21.68	.....

In dollars per long ton.

Monthly Crude Copper Output in Short Tons

	1925	1926				
	Dec.	Jan.	Feb.	March	April	May
Domestic						
Alaska shipments	2,880	3,644	2,556	3,150	3,597	1,797
Butte & Superior	.....	.....	.....	1,243†	.....	.....
Calumet & Arizona	1,682	1,737	1,795	2,010	1,938	2,454
Magma	.....	1,208	1,095	1,255	1,200	1,228
Miami	2,112	2,228	2,109	2,336	2,302	2,298
New Cornelia	3,604	3,664	2,986	3,641	3,634	2,723
Nevada Con	9,777†	.....	.....	9,774†	.....	.....
Old Dominion	1,217	1,291	1,080	1,111	1,132	1,173
Phelps Dodge	6,957	7,586	6,949	7,440	7,033	7,566
Ray Con	18,025†	.....	.....	17,840†	.....	.....
United Verde Extension	1,874	1,987	1,764	1,784	1,730	1,997
Utah Copper	26,723†	.....	.....	26,736†	.....	.....
Tennessee Copper	604	555	503	543	520	555
Foreign						
Boleo, Mexico	773	771	820	898	893	919
Furukawa, Japan	1,579	1,409	1,386	1,586	.....	1,708
Granby Cons., Canada	1,927	1,438	1,482	1,763	1,583	1,700
Union Minière, Africa	6,703	6,827	6,810	7,097	7,050	7,547
Mount Lyell, Aust	1,805†	.....	.....	2,002†	.....	.....
Sumitomo, Japan	1,683	1,188	.....	.....	.....	.....

†Three months.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1924		1925		1926	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	66,631	2,149	74,789	2,412	71,026	2,291
February	65,681	2,265	68,967	2,463	68,131	2,433
March	65,181	2,102	74,901	2,416	75,728	2,443
April	66,073	2,202	70,667	2,356	73,454	2,448
May	65,608	2,116	70,574	2,276	73,651	2,376
June	63,933	2,131	59,894	2,330	.....	.....
July	64,787	2,090	68,507	2,210	.....	.....
August	66,756	2,153	68,090	2,196	.....	.....
September	63,800	2,127	67,720	2,272	.....	.....
October	68,989	2,225	71,042	2,292	.....	.....
November	68,291	2,276	67,400	2,247	.....	.....
December	67,647	2,182	69,566	2,244	.....	.....
Total	793,377	.....	842,117	.....	361,990	.....
Monthly average	66,115	.....	70,176	.....	72,398	.....
Average of daily rate	.....	2,168	.....	2,307	.....	2,397

Company Reports

San Rafael y Anexas Mining Co. Balance Sheet on Dec. 31, 1925

The San Rafael y Anexas company, the principal operation of which is producing silver and gold in the Pachuca district, in Hidalgo, Mexico, earned 448,921 pesos in 1925. Pachuca output was 2,163,180 oz. of silver, and 727,234 oz. came from the company's mine in Jalisco. The balance sheet for the year follows:

Balance Sheet on Dec. 31, 1925

Assets

	Pesos	Pesos
Value of mines, mills, and other property totaly depreciated		
Argentine bonds (mine in Chihuahua)		61,617.43
Cash deposited in embargo	23,638.26	
Expense money advanced	5,547.14	29,185.40
Bills receivable	8,949.89	
Warehouse stocks	294,067.49	
Merchandise in transit	47,625.85	
Ores in treatment	22,649.64	
Products in transit	437,585.80	810,878.67
Cash on hand and in banks		462,577.41
		1,364,258.91

Liabilities

	Pesos	Pesos
Capital stock	110,000.00	
Legal reserve	200,000.00	
Reserve additional	350,000.00	
Profits during year	448,921.24	
Profits remaining previous year	16,309.20	1,125,230.44
Outstanding drafts and checks	69,721.31	
Creditors:		
Repayment old capital uncollected	622.50	
Dividends uncollected	8,169.57	
Liquidation, San Pedro Mining Co.	3,750.00	
Payrolls and bills payable	122,928.34	
Various	33,836.75	239,028.47
		1,364,258.91

United Eastern Shows Results of Oatman Operations

The United Eastern Mining Co. in a recent report to its shareholders publishes the following summary of mining operations at Oatman, Ariz., from 1917 to 1924 inclusive. Milling operations started Jan. 4, 1917, and the last gold ore was ground and fed into the mill on May 31, 1924. Mining and hoisting of ore ceased on May 16, 1924.

Tons mined from Tom Reed Extension claim	511,976
Tons mined from Big Jim claim	220,552
Total tons treated	732,528
Gross value of ore from Tom Reed Extension claim	$10,770,606.39
Gross value of ore in Big Jim claim (includes final mill clean-up)	3,804,128.35
Total gross value of ore treated	$14,574,734.74
Gross value per ton Tom Reed Extension ores	$21.037
Gross value per ton Big Jim ores (includes final mill clean-up)	$17.248
Average gross value per ton (includes final mill clean-up)	$19.874
Average rate of extraction, per cent	96.6
Average operating cost per ton exclusive of depletion, depreciation, federal taxes and litigation expenses. (Throughout the period of the company's operations at Oatman the costs were considerably increased owing to the high prices for labor and supplies which prevailed during and after the war)	$8.254
Average operating cost per ton of $8.254 is made up as follows:	
Mining, development and aerial tramming costs	$4.534
Milling costs	2.011
Marketing	.122
Indirect costs, including superintendence, cottage, general office, legal, accident, fire insurance and other miscellaneous expenses and state taxes	1.391
Administrative expense	.196
Total	$8.254
Average mining cost of $4.534 is made up as follows:	
Labor	$2.581
Timber	.453
Explosives	.502
Miscellaneous supplies, aerial tramming	.714
Power	.284
Total	$4.534
Distributions made to stockholders	$5,997,200.00
Distributions per share (1,363,000 shares outstanding)	4.40

During 1925 the company spent $80,000 as administrative and general expense looking for new properties. Miscellaneous income of $49,000 left a deficit of $31,000.

Butte & Superior Earned $124,554

Butte & Superior Mining Co., for the quarter ended March 31, 1926, shows a net income of $124,554, after depreciation and taxes, but before depletion. This compares with $127,597 in the preceding quarter and $262,429 in the first quarter of 1925.

Statement for the quarter ended March 31, 1926, compares as follows:

	1924	1925	1926
Total income	$852,004	$959,284	$848,593
Expenses	749,057	645,714	686,273
Depreciation and taxes	81,367	51,141	37,766
Surplus before depletion	$21,580	$262,429	$124,554

The company shipped 79,228 tons of zinc ore in the first quarter of 1926 averaging 4 oz. silver per ton and 10.24 per cent zinc, containing a total of 317,412 oz. of silver and 16,229,388 lb. of zinc.

In the first quarter the company also mined 31,813 tons of copper ore averaging 3.91 per cent copper and 6.04 oz silver per ton.

Average prices obtained during the quarter were for silver 66.66c. an ounce, zinc 7.38c. a pound and copper 13.89c. a pound. These prices compare respectively with 69.71c., 8.5c. and 14.18c. in last quarter of 1925.

Good Quarter for Ray Consolidated

The Ray Consolidated Copper Co., operating at Ray, Ariz., and Santa Rita, N. M., during first quarter of 1926 produced as follows:

	Copper Produced, Pounds	Average Monthly Production, Pounds
1926—First quarter	35,679,157	11,893,052
1925—Fourth quarter	36,050,783	12,016,928

During the quarter a total of 1,553,100 tons of ore, averaging 1.38 per cent copper, was treated at the mills, compared with a total of 1,561,000 tons, averaging 1.40 per cent copper, concentrated in the preceding quarter. This is equivalent to a daily average of 17,257 tons in the current quarter, against 16,967 tons per day in the fourth quarter of 1925.

The average mill recovery was 85.80 per cent of the copper contained in the ore milled, corresponding to 23.76 lb. of copper per ton of ore treated, compared to the recovery of 83.19 per cent and 23.37 lb. of copper per ton of ore in the previous quarter.

Net cost per pound of copper produced, after crediting gold and silver and miscellaneous earnings, was 10.20c., compared to a cost of 10.78c. in the quarter ended Dec. 31, 1925. These costs include all operating and general charges of every kind, except depreciation and reserve for federal taxes.

The financial outcome for the quarter, set out in comparison with results for the previous quarter, is shown below:

	First Quarter 1926	Fourth Quarter 1925
Operating profit from copper production	$1,255,914.87	$1,204,973.45
Miscellaneous income, including value of precious metals	97,988.04	100,223.85
Total operating income	$1,353,902.91	$1,305,197.30
Depreciation	240,000.00	209,096.64
Net income	$1,113,902.91	$1,096,100.66

Chief Con. Earned Dividend

A slight reduction in the net value of the ore during the first quarter of 1926, with the tonnage remaining the same, is reported by the Chief Consolidated Mining Co., operating in the Eureka district in Utah. Notwithstanding this, however, the profits were adequate for dividend requirements. Recently, the ore improved in tenor, and with the beginning of operations of the zinc-lead flotation unit of the mill, the earnings from this class of product should be materially increased. The changes in the volatilization department of the mill have all been completed, and a test run is being made on product from the tailings dump of the Eureka Hill mine, which, after careful sampling, has been found

to contain sufficient values to make a satisfactory test and profit by this method of treatment.

The total shipments of ore were 42,757 tons, dry, yielding after transportation, sampling, and all operating charges $115,622. The following data summarize operations,

Metal Contents

Gold, oz	2,423
Silver, oz	531,099
Lead in lead ores, lb	3,201,176
Copper in copper ores, lb	674,495
Lead in zinc-lead ores, lb	3,516,358
Zinc in zinc-lead ores, lb	4,978,463

Assay Values

Gold, oz	0.0566
Silver, oz	12.421
Lead in lead ores, per cent	14.02
Copper in copper ores, per cent	4.48
Lead in zinc-lead ores, per cent	8.50
Zinc in zinc-lead ores, per cent	12.03

	Zinc-Lead Ore	Lead and Dry Ores
Average gross value per ton	$40.96	$28.96
Smelting, freight and sampling per ton	29.22	12.98
Average net values	$11.74	$15.98

Current assets on March 31 were $307,111, against liabilities of $122,936.

U. S. Copper Statistics

The U. S. Department of Commerce has just issued the following summary of features of the copper industry in the United States in 1924 and 1925:

	1924	1925
Production of copper		
Smelter output, pounds	1,634,249,192	1,674,869,886
Mine production, pounds	1,606,165,018	(a)
Refinery production of new copper		
Electrolytic, pounds	1,499,223,447	1,533,995,439
Lake, pounds	145,333,227	138,029,764
Casting, pounds	29,657,925	10,870,144
Total domestic, pounds	1,674,214,599	1,682,895,347
Total domestic and foreign, pounds	2,260,076,010	2,204,573,824
Total new and old copper, pounds	3,037,000,000	3,045,000,000
Ore produced		
Copper ore, short tons	49,178,315	(a)
Average yield of copper, per cent	1.59	(a)
Copper-lead and copper-zinc ores, short tons	219,874	(a)
Average price per pound, cents	13.1	14.2
Imports (unmanufactured) pounds	768,813,731	652,973,407
Exports of metallic copper (b), pounds	1,116,775,136	1,082,369,439
Withdrawn from total supply on domestic account		
Total new copper, pounds	1,354,742,564	1,401,012,091
Total new and old copper, pounds	2,131,000,000	2,241,000,000
Stocks of refined copper (c), pounds	234,000,000	124,000,000
Stocks of blister and materials in soludion (c)	393,000,000	(d) 432,000,000
Value of production in the United States	$214,087,000	$237,832,000
World's production, pounds	2,945,423,000	(a)

(a) Figures not yet available. (b) Total exports of copper, exclusive of ore, concentrates, composition metal, and unrefined material. (c) At the end of the year. (d) Subject to revision.

Imports and Exports of Ores and Metals in May, 1925 and 1926

Compiled from the U. S. Department of Commerce Records

In pounds unless otherwise specified

Imports

	May, 1925	May, 1926
Antimony		
Ore, Gross weight	.....	673,900
Ore, Antimony content	.....	530,476
Liquated regulus or metal	930,684	666,720
Copper		
Ores	22,208,029	15,319,559
Concentrates	2,809,115	1,436,645
Regulus, coarse metal, and cement copper	259,211	2,910
Imported from		
Spain	1,914,967	1,966,123
Canada	6,956,295	6,317,399
Mexico	2,038,520	1,814,591
Cuba	1,850,240	.....
Chile	11,815,338	6,535,037
Peru	22,222	13,494
Other countries	678,773	112,470
Unrefined black, blister, and converter copper in pigs	31,412,309	32,117,787
Imported from		
Spain	4,567,181	4,837,854
Canada	5,556,000	5,491,712
Mexico	6,948,000	11,042,780
Chile	5,962,828	4,925,036
Peru	1,140,734	3,730,623
Portuguese Africa	4,963,041	1,646,507
Other countries	2,274,525	443,275
Refined copper	8,281,292	12,656,842
Old and clippings for remanufacture	485,673	651,846
Composition metal, copper chief value	.....	.....
Brass		
Old and clippings for remanufacture	652,007	527,725
Lead		
Ore and matte	4,487,200	7,875,155
Bullion or base bullion	16,063,914	17,084,247
Pigs and bars	.....	560,124
Scrap lead, babbitt metal, solder and other forms (lead content)	59,263	185,186
Type metal and antimonial lead, Gross weight	.....	47,615
Type metal and antimonial lead, Lead content	.....	20,599
Manganese ore, tons, Gross weight	3,217	29
Manganese ore, tons, Manganese content	25,922	21,633
Pyrites	53,446	63,351
Tin		
Ore, tons	.....	22
Bars, blocks, and pigs	8,617,387	13,797,800
From		
British Malaya	5,108,658	6,193,490
United Kingdom	2,628,900	2,488,420
China	.....	56,155
Dutch East Indies	58,263	1,200,701
Hongkong	235,743	2,164,152
Australia	100,800	72,800
Other countries	485,023	1,622,082
Zinc		
Ore, zinc content	4,072,650	287,264
Blocks, pigs, and old	751	1,576

Exports of Copper, Lead and Zinc

	May, 1925	May, 1926
Copper		
Ores, concentrates, composition metal, and unrefined	1,064	650,323
Refined in ingots, bars, and other forms	103,325,236	66,684,851
Exported from		
Belgium	5,980,141	6,803,283
France	17,973,376	14,794,376
Germany	23,999,954	9,005,208
Italy	7,758,069	10,210,984
Netherlands	14,359,895	6,216,739
Spain	1,220,513	749,860
Sweden	2,532,276	1,411,874
United Kingdom	21,127,462	10,809,371
Other Europe	1,424,915	201,530
Canada	1,659,714	1,169,329
British India	1,351,453	.....
China	2,762,900	1,052,800
Japan	1,063,807	2,026,661
Other countries	110,761	2,232,836
Old and scrap	1,321,485	2,149,976
Pipes and tubes	277,818	226,938
Plates and sheets	2,227,887	165,538
Rods	4,714,890	2,427,995
Wire	1,459,959	869,956
Insulated copper wire and cable	1,267,423	1,722,850
Lead		
In pigs, bars, and other forms		
From domestic ore	305,836	69,792
From foreign ore	20,888,050	9,250,392
Exported to		
Belgium	896,343	448,094
France	1,400,381	907,501
Germany	5,635,524	2,072,467
Italy	515,322	224,024
Netherlands	224,019	448,063
United Kingdom	8,904,876	112,007
Other Europe	425,730	426,657
Argentina	481,651	1,224
Brazil	728,126	403,302
Japan	1,568,044	2,576,914
Other countries	413,870	1,699,931
Other lead manufactures	1,515,956	2,096,075
Zinc		
Ore and concentrates, tons	34	6,342
Dross	2,558,982	860,794
Cast in slabs, blocks or pigs	12,000,406	5,201,331
Exported to		
Belgium	111,962	420,973
France	1,904,487	302,438
Germany	279,996	708,731
Italy	2,868,540	33,639
Netherlands	351,553	25,175
United Kingdom	5,417,083	1,233,008
Other Europe	135,196	.....
Argentina	448,212	.....
British India	56,020	335
Other countries	427,357	2,477,030
Sheets, strips, other forms	640,621	877,106
Dust	308,701	172,375
Other zinc manufactures	91,522	113,949

Mining Stocks—Week Ended June 26, 1926

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	48⅛	44¼	46¼	Jy.17, Au.23 Q	0.75
Arcadian Consol.	Boston	*70	*70	*70		
Ariz. Com'l	Boston	11⅛	10⅛	10⅛	Jy.21, Jy. 31 SA	0.50
Calaveras	N. Y. Curb	1⅛	1⅛	1⅛		
Calumet & Arizona	New York	69¼	64⅛	64⅞	Jn. 4, Jn. 21 Q	1.50
Calumet & Hecla	Boston	14½	14¼	14⅜	Jn. 1, Jn. 15 Q	0.50
Cerro de Pasco	New York	66⅛	64½	65	Jy. 15, Au. 2, Q	1.00
Chile Copper	New York	33½	32⅛	33	Jn. 2, Jn. 28, Q	0.62½
Chino	New York	23	21½	21½	Sept., 1920	0.37½
Con. Coppermines	N. Y. Curb	3⅛	3	3⅛		
Copper Range	Boston	15⅛	14¼	14¼	May, 1925	1.00
Crystal Copper	Boston Curb	*40	*34	*37		
East Butte	Boston	3¼	3	3¼	Dec., 1919	0.50
First National	Boston Curb	....	....	*16	Feb., 1919	0.15
Franklin	Boston			*40		
Granby Consol.	New York	21⅛	20	20¼	May, 1919	1.25
Greene-Cananea	New York	16⅛	15	15⅛	Nov., 1920	0.50
Hancock	Boston			*50		
Howe Sound	New York	38⅛	34⅛	37⅞	Ap.1, Ap.15	0.75
Inspiration Consl.	New York	24⅛	23¼	23¼	Jn.7, Jy.6, Q	0.50
Iron Cap	Boston Curb	3⅜	3⅛	3⅜	Jn. 1, Jn. 15	0.50
Isle Royale	Boston	11	10⅛	10⅛	Jn. 1, Jn. 15	0.50
Jerome Verde Dev.	N. Y. Curb	*60	*60	*60		
Kennecott	New York	55⅛	54	54	Jn. 4, July 1 Q	1.00
Lake Copper	Boston			*80	June, 1925	0.50
Magma Copper	New York	39⅛	38	38⅛	Jn.30, July.15, Q	0.75
Mason Valley	N. Y. Curb	1¼	1¼	1¼		
Mass Consolidated	Boston	*40	*25	*25	Nov., 1917	1.00
Miami Copper	New York	13⅜	13	13⅛	My.1, My.15 Q	0.25
Mohawk	Boston	35⅛	32⅛	33⅛	My.1, Je.1 Q	1.00
Mother Lode Coa.	New York	6	5⅛	5⅛	Jn. 15, Jn. 30	0.37½
Nevada Consol.	New York	13⅞	13	13⅜	Jn. 15, Jn. 30 Q	0.25
New Cornelia	Boston	20⅜	20	20	My.7, M.24 Q	0.40
North Butte	Boston	2⅝	2½	2⅝	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*60	*60	*60	No. 14, De. 2	0.05
Old Dominion	Boston	16⅛	15⅞	15⅞	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†130	†120		Jun.22, July2 Q	1.50
Quincy	Boston	19	18⅞	19	Mar., 1926	1.00
Ray Consolidated	New York	14	13⅛	13⅜	Ap.20, Ap.30	0.25
Ray Hercules	N. Y. Curb			11⅞		
St. Mary's Min. Ld.	Boston	28⅛	27⅜	28⅛	Ap.17, My.18	2.00
Seneca Copper	New York	5⅛	5⅛	5⅛		
Shannon	Boston			*50	Nov., 1917	0.25
Superior & Boston	Boston	*75	*75	*75		
Tenn. C. & C.	New York	12⅛	11⅞	12	My. 29 Ju.15, Q	0.25
United Verde Ex.	N. Y. Curb	28	27⅜	28	Jy.17, Aug. 2,	0.75
Utah Copper	New York	100	100	100	Jn.15, Jn.31 Q	1.25
Utah Metal & T.	Boston	1⅛	1 7/16	1⅛	Dec., 1917	0.30
Victoria	Boston			*41		
Walker Mining	Salt Lake	*52	*52	*52		
NICKEL-COPPER						
Internat. Nickel	New York	37⅛	35⅛	35⅞	Jn.17, Jn.30,	Q0.50
Internat. Nickel, pfd.	New York	....	....	104	Ap.15, My.1, Q	1.50
LEAD						
Gladstone M. M. Co.	Spokane	*34⅛	*33⅛	*34	Jn. 10, July 10	0.1⅛
National Lead	New York	160⅞	157⅝	157⅝	Jn. 11, Jn. 30 Q	2.00
National Lead pfd.	New York	118⅛	118⅛	118⅛	My.21, Je.15 Q	1.75
St. Joseph Lead	New York	42¼	40½	40⅝	Jn.10, Jn.21 QX	0.75
ZINC						
Am. Z. L. & S.	New York	7⅛	7⅛	7⅛	May., 1920	1.00
Am. Z. L. & S, pfd.	New York	34⅛	31¼	31¼	Nov., 1920	1.50
Butte C. & Z.	New York	5⅜	5	5	De.10, De.24	0.50
Butte & Superior	New York	10⅛	10⅛	10⅛	Jn.15, Jn.30 Q	0.50
Callahan Zn-Ld	New York	1⅛	1⅛	1⅛	Dec., 1920	0.50
Eagle Picher	Cincinnati	28⅛	28⅛	28¼	My. 15, Jn.1	0.40
Eagle Picher, pfd.	Cincinnati	....	....	110	Jn.30, Jy.15 Q	1.50
New Jersey Zn.	N. Y. Curb	....	....	208	Jn.9, Jy.10 Q	2.00
United Zinc	N. Y. Curb			*70		
Yellow Pine	Los Angeles	*25	*25	*25	De.8, De.18 Q	0.04
GOLD						
Alaska Juneau	New York	....	....	1⅜		
Argonaut	Toronto	*22	*19½	*20		
Barry-Hollinger	Toronto	*48½	*44¼	*46½		
Carson Hill	Boston	*35	*30	*30		
Consol. W. Dome L.	Toronto	*14⅛	*14	*14		
Cresson Consol. G.	N. Y. Curb	2 1/16	1⅞	2	Mh.31, Ap.10	0.10
Crown Reserve	Toronto	*10½	*9	* 9	Jan., 1917	0.05
Dome Mines	New York	14⅜	13½	13⅝	Jn.30, July 20, Q	0.50
Golden Center	N. Y. Curb	1⅜	1⅛	1⅛		
Golden Cycle	Colo. Springs	†1.48	†1.46	....	No.30, Dec.10 Q	0.03
Hollinger Consol.	Toronto	20.00	19.65	19.85	Jn.29, Jy.15 Q	0.10
Homestake Mining	New York	54	54	54	Jn.19, Jn.25 M	0.50
Kirkland Lake	Toronto	1.06	1.03	1.05		
Lake Shore	Toronto	11.40	11.30	11.35	Jn.1, Jn. 15 Q	0.10
McIntyre-Porcupine	New York	25½	25	25	My.1, Jn.1	0.25
Newray	Toronto	....	....	*33		
Noranda	N. Y. Curb	15⅛	15	15		
Portland	Colo. Springs	†*50½	†*48	....	July6, July15	0.02
Rand Mines	New York	....	....	33½	Fe.16, Fe.26	1.52
Teck-Hughes	Toronto	3.65	3.61	3.62	Jn. 15, Fe. 1	0.05
Tom Reed	Los Angeles	*60	*60	*60	Ma.10 Ma.20	0.02
Tough-Oakes	Toronto	*44	*41	*41		
United Eastern	N. Y. Curb	*30	*30	*30	July, 1924	0.05
Vipond Cons.	Toronto	1.75	1.69	1.71		
Wright-Hargreaves	Toronto	8.45	8.10	8.45	Jn.15, Jy.1 Q X	0.07½
Yukon-Alaska Trust	N. Y. Curb	21½	21	21		
GOLD AND SILVER						
Carnegie Metals	Boston	....	....	16½		
Con. Cortez	N. Y. Curb	....	....	*6		
Con. Virginia	San Francisco	*6½	*5½	*5½		
Continental Mines	N. Y. Curb	....	....	*45		
Dolores Esperanza	N. Y. Curb	....	....	*39	July, 1923	0.05
Premier Gold	N. Y. Curb	2⅛	2 1/16	2⅛	Jn.18, Jy.3 Q	0.08
Tonopah Belmont	N. Y. Curb	....	....	3 1/16	Se.15, Oc.1	0.05
Tonopah Extension	N. Y. Curb	*45	*45	*45	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	6½	6	6	Ap.7, Ap.21 Q	0.07½
Unity Gold	N. Y. Curb	...	...	*20		
West End Consol.	N. Y. Curb	...	...	*16	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	....	....	*30	June, 1918	0.02

Stock	Exch.	High	Low	Last		Last Div.
SILVER						
Alvarado	N. Y. Curb	....	....	1	Oct., 1920	0.50
Beaver Consol.	Toronto	*76	*75	*75½	May. 1920	0.03
Castle-Trethewey	Toronto	1.47	1.43	1.43		
Coniagas	Toronto	3.25	3.10	3.25	May, 1924	0.12½
Keeley	Toronto	1.48	1.40	1.41	Ma. 1, Ma. 15	X0.12
Kerr Lake	N. Y. Curb	....	....	1	Ap.1, Ap.15	0.12½
La Rose	Toronto	*13	*11	*12	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	....	....	*85	Jy. 2, Jy. 15	0.05
McKinley-Dar.-Sav.	Toronto	*15	*12⅜	*15	Oct., 1920	0.03
Mining Corp. Can.	Toronto	3.60	3.55	3.58	Jy.1, Jy.15	0.12½
Nipissing	N. Y. Curb	5⅛	5⅛	5⅛	Jn.30, Jy.20	0.15
Temiskaming	Toronto	*14	*11	*11	Jan., 1920	0.40
SILVER-LEAD						
Ahumada	New York	8⅛	7⅛	8	Jn.18, Jy.5 Q	X0.25
Alta Merger	Salt Lake	†*5½	†*2			
Bingham Mines	Boston	36⅜	34⅛	34⅞	Jn.19, Jn.30 Q	1.00
Cardiff M. & M.	Salt Lake	*55	*50	*50	De.16, No.18	0.10
Chief Consol.	Salt Lake	....	....	2.90	Ap.1, My.1 Q	0.10
Emma Silver	Salt Lake	†*75	†*50			
Erupcion	Boston Curb	....	....	1⅛	Jn.18, Jy.5, QX	0.10
Federal M. & S.	New York	81	79	79		
Federal M. & S., pfd.	New York	77	71¼	71½	My.25, Ju.15 Q	1.75
Hawthorne Mines	N. Y. Curb	*21	*18	*20		
Hecla Mining	N. Y. Curb	17⅛	17⅛	17⅛	My.15, Je.15 Q	0.50
Iron King Mining	Salt Lake	*26	*26	*26		
Keystone Mining	Salt Lake	*28	*25½	*25½	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*18½	*17½	*18½		
Mammoth Mining	Salt Lake	2.85	2.85	2.85	Mar.24, Apr. 1	0.10
Marsh Mines	Spokane	*3½	*2⅜	*3½	Se.15, Oc.1	0.1⅜
Park Utah	New York	6.50	6.50	6.50	Jn.15, Jy.1 Q	0.15
Prince Cons.	Salt Lake	....	....	1⅜		
Silver King Coal	Salt Lake	....	....	9.25	Jn.21, July1, Q	0.25
Silversmith	Spokane	*48⅜	*47	*47	Jn.30, Jy.10 Q	0.02
Tamarack-Custer	Spokane	*30	*25	*29½	Sept., 1924	0.25
Tintic Standard	Salt Lake	12.75	12.62½	12.62½	Jn.16, Jn.26,	0.40
Utah-Apex	Boston	9⅛	7 1/16	7⅛	Jy. 3, Jy.15 Q	0.25
Western Utah Copper	N. Y. Curb	...	...	*8		
IRON						
Bethlehem Steel	New York	42⅜	40⅜	41	July, 1924	1.25
Colorado Fuel & Iron	New York	43⅜	40⅛	40⅞	May, 1921	0.75
Gt. North'n Iron Ore	New York	22⅛	21⅜	21⅝	De. 4, De. 28,	0.75
Inland Steel	New York	39⅛	39	39	My.10, Je.1 Q	0.75
Mesabi Iron	New York	1⅛	1⅛	1⅛		
Replogle Steel	New York	10	9⅞	9⅞		
Republic I. & S.	New York	53⅞	50¼	51	May, 1921	1.50
Republic I. & S. pfd.	New York	....	....	94½	Jn.15, July1, Q	1.75
Sloss-Sheffield S. & I.	New York	133¼	130	130	Jn.10, Jn.21 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	107	104	107	Jn 21, July.1, Q	1.75
U. S. Steel	New York	139⅛	135⅛	137⅝	Jn.2, Jn.29 Q	1.75
U. S. Steel pfd.	New York	129⅞	128⅜	129¼	My.4, My.29, Q	1.75
Virginia I. C. & C.	New York	....	....	50	Jan., 1924	1.50
Virginia I.C.&C.pfd	New York			73	Jn.1, July 2,	2.50
ALUMINUM						
Alum. Co. of Amer.	N.Y. Curb Ind.	74⅛	74	74		
Alum. Co. of Amer pf.	N.Y. Curb Ind.	....	....	99⅜	June 15, July 1, Q	Q0.01½
VANADIUM						
Vanadium Corp.	New York	36⅛	35⅛	35⅛	My.1, My.15, Q	0.75
ASBESTOS						
Asbestos Corp., New	Montreal	22	21	21⅛	De.31, Ja.15 Q	1.50
Asbestos Corp., pfd.	Montreal	77⅜	75¼	77⅛	Jy.1, Jy.15, Q	1.75
SULPHUR						
Freeport Texas	New York	33	31	31¼	Nov., 1919	1.00
Texas Gulf	New York	144¼	140½	141½	Jn.1, Jn. 15, Q	2.50
DIAMONDS						
De Beers Consol.	New York	35⅛	35⅛	35⅛	Ja.26, Fe.2,	0.23
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	5⅛	4⅞	5⅛		
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	52⅜	51	51	My.20, Je. 1, Q	1.00
Amer. Metal pfd	New York	....	....	114	My.20, Je. 1 Q	1.75
Amer. Sm. & Ref.	New York	130⅞	126½	127½	Jy.10, Au 2, Q	1.75
Amer. Sm.&Ref.pfd.	New York	118⅜	117½	117½	Au.7, Se 1, Q	1.75
Consol. M. & S.	N. Y. Curb	....	....	208	Jn.30, Jy.5 QX	3.75
Federated Metals	N. Y. Curb	12½	12¼	12¼		
Newmont Mining	N. Y. Curb	56⅛	55	55⅛	Mar.31, Apr.15,	0.60
Southwest Metals	N. Y. Curb	....	....	1	Jn.30, Jy.15	0.60
U. S. Sm. R. & M.	New York	42⅜	40¼	41	Ap.8, Ap.15, Q	0.87½
U. S. Sm. R.&M.pfd.	New York	....	....	49⅞	Ap.8, Ap.15, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

PRICE WEEK ENDED JUNE 15, 1926

Name	High	Low	Last	Last Divd. Date	Amount
Aramayo Mines (25 frs.)	79/6	78/9	78/9	May. 1926	5 p.c.†
British Platinum (£1)	6/1½	5/—	6/—	Feb. 1925	2½ p.c.
Burma Corpn. (10 rupees)	16/3	14/6	16/—	Feb. 1926	6 annas*
Bwana M'Kubwa (5s)	8/3	7/9	8/—		
Camp Bird (£1)	5/—	4/9	5/—		
El Oro (£1)	6/3	5/10½	6/1½	Nov. 1924	2½ p.c.*
Esperanza (10s)	1 1⅛	—/10½	1/—		
Frontino & Bolivia (£1)	7/6	7/3	7/6	July 1926	2½ p.c.
Mexican Corpn. (£1)	17/—	16/—	16/9		
Mexico Mines of El Oro (£1)	30/—	28/9	30/—	Dec. 1925	12½ p.c.*
Oroville Dredging (£1)	4/—	3/9	4/—	Dec. 1923	3½ p.c.
Ouro Preto (£1)	2/3	2/1½	2/3	May 1925	2½ p.c.
Rhodesian Congo Border	130/—	122/6	L27/6		
St. John del Rey (£1)	10/4½	9/6	9/9	June 1925	6½ p.c.
San Francisco Mines (10s)	29/3	28/7½	29/—	June 1926	22½ p.c.
Santa Gertrudis (£1)	21/10½	20/6	20/6	July 1926	5 p.c.
Selukwe (2s. 6d.)	11/6	11/—	11/6	April 1917	6¾ p.c.
S. Amer. Copper (2s.)	4/7½	4/1½	4/6	Nov. 1917	75 p.c.
Tanganyika (£1)	43/9	38/—	40/—	Sept. 1925	5 p.c.
Tomboy (£1)	3/9	3/4½	3/9	Jan. 1926	5 p.c.
Union Miniere du Haut-Katanga (Brussels)	6.875	6.555	6.850	July 1925	150 frs.‡

* Free of British income tax. † Swiss frs. ‡ Belgian frs.